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TREMATODES FROM FISHES MAINLY
FROM THE WOODS HOLE REGION
MASSACHUSETTS

BY
EDWIN LINTON

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TREMATODES FROM FISHES MAINLY FROM THE WOODS HOLE REGION, MASSACHUSETTS

By EDWIN LINTON ¹

INTRODUCTION

IT HAS BEEN my privilege, during a long series of years, to spend the summer months at the laboratory of the United States Bureau of Fisheries, at Woods Hole, Mass. During that time considerable attention was given to a study of the distribution of the helminth parasites of fishes. Through the cooperation of the late Vinal N. Edwards, collections and observations were made so as to cover all the months of the year. All collections in the months of October to May, inclusive, and the greater number of those in June and September, were made by Mr. Edwards. The majority of the collections in July and August, and a few of those in June and September, were made by the author.

Reports on a few trematodes from fishes not of the Woods Hole region are herein included. When not stated otherwise it is to be understood that digenetic forms came from the intestine and monogenetic forms from the gills. In many cases in which the same species of trematode is accredited to more than one species of fish, measurements are given of examples from different hosts, and record made of differences noted.

¹ Dr. Linton died on June 3, 1939, a few days before this paper was sent to the printer.—Ed.

Much difficulty is experienced when one attempts to identify alcoholic or formalin specimens of these soft-bodied forms, which not only assume diverse contraction shapes but may vary considerably in the size and relative proportions and positions of parts with the age of the individuals. No special search was made for monogenetic forms. Such as were found had usually been washed off the gills while preparing the viscera for examination. In the summers of 1912 to 1927 such helminths from the gills and skin of fishes as were met with were turned over to Dr. G. A. MacCallum, who was giving especial consideration to the monogenetic trematodes.

The author is under obligations to Drs. H. W. Manter and H. W. Stunkard for information that has prevented some duplication of names as a result of work carried on by them on forms noted in this report.

The invaluable index catalog of Stiles and Hassall² renders it unnecessary, in most cases, to cite literature prior to 1908. For the convenience of future investigators, however, frequent references have been given to earlier papers of the author, on trematodes from the Woods Hole region.

The names of fishes used in this report are those given in the check list of Jordan, Evermann, and Clark.³

Order MONOGENEA van Beneden, 1858

Suborder MONOPISTHOCOTYLEA Odhner, 1912

Family GYRODACTYLIDAE van Beneden and Hesse, 1863

Subfamily GYRODACTYLINAE Monticelli, 1892

Genus GYRODACTYLUS Nordmann, 1832

GYRODACTYLUS species

PLATE 14, FIGURE 158

On August 6, 1911, Dr. R. A. Spaeth called my attention to certain small monogenetic trematodes (U.S.N.M. No. 8142) on the scales of the common killifish (*Fundulus heteroclitus*). Later, on August 18, Dr. C. W. Hahn, who was examining killifishes for sporidia, reported these worms abundant on fishes he had been examining.

Measurements, life: Length, 0.5 mm.; breadth, anterior, 0.05 mm.; maximum, a little back of middle, 0.12 mm.; length of large hooks,

² Index-catalogue of medical and veterinary zoology. Subjects: Trematodes and trematode diseases. U. S. Hyg. Lab. Bull. 37, 401 pp., 1908.

³ Check list of the fishes and fishlike vertebrates of North and Middle America north of the northern boundary of Venezuela and Colombia. Rep. U. S. Comm. Fish. 1928, pt. 2, 670 pp., 1930.

0.07 mm. The anterior end is bilobed, each lobe bearing a small contractile papilla. The posterior sucker bears two larger hooks symmetrically placed, one on each side of the median line, and about 18 small hooks and 2 spines on the margins.

These worms perform active looping movements, attaching themselves by the anterior end; then, releasing the posterior sucker, they rapidly loop themselves forward.

Subfamily TETRAONCHINAE Monticelli, 1903

Genus ANCYROCEPHALUS Creplin, 1838

ANCYROCEPHALUS PARVUS, new species

PLATE 14, FIGURES 159, 160

Body elliptical, narrowed abruptly at anterior end, which bears four blunt projections, and two pairs of eye spots; pharynx longer than broad; posterior disk with 18 hooks, 4 median pairs, 5 hooks on each lateral margin, and 2 transverse bars. The two median hooks are somewhat larger than the others. The cirrus pouch is pyriform, the cirrus long and filiform; seminal vesicle long-pyriform, beside cirrus pouch, ventral and posterior to the pharynx. Ovary median, longer than broad; seminal receptacle on left side at anterior border of vitellaria; follicles of vitellaria dense, filling all but a small portion of the anterior end of the body from the margins to the ovary and testis on the median line, and extending to the posterior end. One testis, longer than broad, on median line behind the ovary. Measurements in balsam: Length, 0.73 mm.; breadth, anterior end 0.1 mm., middle 0.5 mm.; pharynx, length 0.07 mm., breadth, 0.05 mm.; length of longest hooks 0.024 mm.

Average of 5: Length, 0.82 mm.; breadth, 0.38 mm. Longest, length 1.08 mm., breadth 0.34 mm.; shortest, length 0.67, breadth 0.39 mm.

Measurements, life (U.S.N.M. No. 8143): Length, 0.84 mm.; breadth, anterior (head) 0.1 mm., middle, maximum, 0.42 mm., posterior (caudal disk) 0.14 mm.

The middle of the body was traversed by strong, longitudinal muscle fibers, and by less strong longitudinal fibers along the lateral margins. The head carried four club-shaped projections, which, in a specimen fixed over the flame, broke up into longitudinal striae.

Type specimens.—U.S.N.M. No. 8143 (holotype and paratypes).

Host.—Garfish (*Strongylura marina*).

Record of collection.—Ten, collected on August 30, 1911, from gills of host.

Genus AMPHIBDELLA Chatin, 1874**AMPHIBDELLA FLAVOLINEATA MacCallum**

Amphibdella flavolineata MACCALLUM, Zoopathologica, vol. 1, No. 1, p. 29, 1916.

On August 3, 1910, 16 trematodes were collected from the gills of a torpedo (*Tetranarce occidentalis*) that had been taken in a fish trap at Menemsha Bight.

Color, white. Measurements, life: Length, 3.78 mm.; breadth, maximum, about middle, 0.64 mm., in front of caudal disk 0.29 mm.; breadth of caudal disk, 0.42 mm. On July 17, 1911, we found U.S.N.M. No. 8144, and again, on July 7, 1914, several were collected from the gills of torpedoes.

As Dr. MacCallum had taken up the study of the monogenetic trematodes at Woods Hole in the summer of 1912, I made no further collections from the gills of the torpedo, but on August 3, 1920, I noted that they were numerous on the gills of one that was examined on that date for parasites. The specimens collected correspond to *A. flavolineata* MacCallum.

Family MONOCOTYLIDAE Taschenberg, 1879**Subfamily DIONCHINAE Johnston and Tiegs, 1922****Genus DIONCHUS Goto, 1899****DIONCHUS AGASSIZI Goto****PLATE 14, FIGURES 162, 163**

Dionchus agassizi Goto, Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 12, pp. 286-291, figs. 19-21, 1899.

I have record of the finding of this trematode on the gills of remora on three occasions. The anterior end is broadly sagittate, with mouth at base of triangular head. In the living worm toothlike processes are very indistinct. The body is of nearly uniform breadth until near the posterior end, where it tapers to the posterior sucker. The posterior sucking disk in this species is characterized by being divided into 10 areas by as many radial ridges, which do not quite reach the center of the disk. On account of the contracted condition of the disk, and its position, showing only in lateral view in all but one of the mounted specimens, its structure cannot be made out satisfactorily. In the one specimen in which a ventral view of the disk is shown, no radial ridges can be distinguished. The distal ends of the two hooks on the disk of each of the mounted specimens are broken off. They are described by Goto as being clawlike. He

also states that they usually are broken off in the process of removing them from their host.

Measurements in balsam: Length, 2.31 mm.; maximum breadth, at level of mouth, 0.48 mm.; breadth at middle, 0.45 mm.; in front of posterior sucker 0.14 mm.; distance of mouth from anterior end 0.35 mm.

Host.—Remora (*Remora remora*).

Record of collections.—Three, collected on July 28, 1910, from gills of host. Small, white; two short, stout hooks on posterior sucking disk; four eye spots dorsal to mouth. Dimensions, life: Length, 1.72 mm.; breadth, at mouth 0.7 mm., middle 0.56 mm.; posterior disk, length 0.42 mm., breadth 0.35 mm.

One, collected July 21, 1911, from gills of host.

One (U.S.N.M. No. 8147), collected August 3, 1911, from gills of host.

Family UDONELLIDAE Taschenberg, 1879

Genus LINTONIA Monticelli, 1904

LINTONIA PAPILLOSA (Linton)

Nitzschia papillosa LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 508, 509, pl. 40, figs. 1-7, 1898.

Lintonia papillosa (Linton), MONTICELLI, Arch. Zool. Napoli, vol. 2, pp. 117-124, pl. 7, figs. 1-7, 1904.

Seventeen examples of this species (U.S.N.M. No. 8146) were collected by Vinal N. Edwards, April 10, 1913, from the common cod-fish (*Gadus morrhua*), taken on Georges Bank.

Measurements in formalin: Smallest, length, 1.12 mm.; diameter, lateral view, 0.28 mm. Largest, length, 2.1 mm.; diameter, lateral view, 0.53 mm.

Family CAPSALIDAE Baird, 1853

Subfamily BENEDENIINAE Johnston, 1931

Genus ENTOBDELLA Blainville, 1818

ENTOBDELLA BUMPUSH (Linton)

Epibdella bumpushi LINTON, Bull. U. S. Fish Comm. for 1899, pp. 286, 287, figs. 11-15, 1900.

Since the publication of the original description of this species I find among my notes record of this trematode on two occasions, both from the skin of the stingray (*Pastinachus centrourus*).

Record of collections.—One, collected June 24, 1921; length, about 11 mm.

One (U.S.N.M. No. 8148), collected July 1, 1924, from skin of host, ventral side; length, 14 mm.; breadth, 8 mm.

ENTOBDELLA HIPPOGLOSSI (O. F. Müller)

PLATE 14, FIGURES 164-169

See STILES AND HASSALL, U. S. Hyg. Lab. Bull. 37, p. 252, 1908, for references.

I have records of this trematode from the skin of the halibut (*Hippoglossus hippoglossus*) as follows:

Record of collections.—Four (U.S.N.M. No. 8149), collected by Vinal N. Edwards, June 15, 1906. In formalin specimens the suckers, narrow margins of the body, testes, and genitalia in front of the testes are white, elsewhere the color is purplish.

Received from the U. S. National Museum two specimens on December 7. Label: On halibut, Ward's Natural Science Establishment; acc. 11828. These agree closely with van Beneden's description of this species.

TABLE 1.—*Measurements of two specimens of Entobdella hippoglossi in glycerin and in balsam*

| Measurement | Specimen 1 | | Specimen 2 | |
|--------------------------------|------------|------------|------------|------------|
| | Glycerin | Balsam | Glycerin | Balsam |
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 17.00 | 13.50 | 10.00 | 8.50 |
| Breadth..... | 9.00 | 7.00 | 7.00 | 7.50 |
| Anterior suckers, length..... | 1.53 | .77 | 1.20 | 1.33 |
| Anterior suckers, breadth..... | .56 | .51 | .70 | .63 |
| Posterior sucker, length..... | 4.75 | 4.00 | 4.50 | 4.50 |
| Posterior sucker, breadth..... | 5.25 | 3.50 | 4.50 | 4.50 |
| Length of anterior hook..... | .42 | .42 | .56 | .74 |
| Length of middle hook..... | .84 | .70 | .98 | 1.40 |
| Length of posterior hook..... | .16 | .16 | ..... | .12 |

Subfamily CAPSALINAE Johnston, 1929

Genus TRISTOMA Cuvier, 1817

TRISTOMA PAPILLOSUM Diesing

PLATE 14, FIGURES 170-174

Tristomum coccineum Cuvier, LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 509, 510, pl. 40, fig. 9, 1898; Bull. U. S. Fish Comm. for 1899, p. 278, 1900; *ibid.*, p. 448, 1901; Bull. U. S. Bur. Fish., vol. 31, pt. 2, p. 585, 1911.

Beginning with the season of 1912, Dr. G. A. MacCallum undertook investigations on the monogenetic trematodes of the Woods Hole region, and thereafter such gill and skin parasites as I came

across in my study of the food and internal parasites of fishes were turned over to him. Following are notes on tristomes from the gills of the swordfish (*Xiphias gladius*), collected on July 15, 1904, and July 13, 1911 (U.S.N.M. No. 8150). On the former date three tristomes were collected from the gills of one swordfish; on the latter date two swordfish were examined and 75 tristomes obtained from the gills of one; none was found on the other. Those of the first lot were yellowish, transparent, leaflike, and from 7 to 12 mm. or more in diameter. In the second lot they were pinkish to blood-red, becoming pale when much extended. Some of them, which soon became inactive, were blood-red with a white border. This marginal border bore clusters of small spines of various shapes (pl. 14, fig. 172). After lying overnight in sea water most of the worms, which had been active on the evening before, were still active. When the table was slightly jarred, the more active worms would contract quickly. The largest, when expanded, were 20 mm. or more in length and 15 mm. or more in breadth. They were then very thin, leaflike, transparent, yellowish white. When touched they contracted quickly, the length being much lessened, but the breadth remaining about the same. Upon repeated irritation they would become nearly circular in outline, the color in the contracted state being deep pink. Eggs dark brown, tetragonal, with a filament at each of the four trihedral angles, one filament being longer than the others; diameter, excluding filaments, 0.1 mm.

In a lot of 93 tristomes, all but two belong to this species. These vary greatly in size and shape. Of 31 specimens mounted in balsam, 25 are longer than broad, 4 are broader than long, and 2 have the length and breadth equal. Smallest, length, 4 mm., breadth, 2 mm.; largest, length, 13 mm., breadth, 9 mm. In 20 specimens, average length, 8.6 mm., breadth, 7.2 mm., the average number of groups of spines on one lateral margin was 45.6; maximum 51, minimum 40. There are two small, slender, slightly arcuate spines on the posterior sucker. These spines were 0.12 mm. in length and 0.02 mm. in breadth, on a specimen 5 mm. in length and 6 mm. in breadth, and on another 12 mm. in length and 10 mm. in breadth. In most cases these spines were situated in front of the posterior central loculus, but in four cases they were observed to be in front of the left posterior loculus, and in one at the central end of the right lateral loculus. The posterior dorsal surface of these worms is papillate; also, in strongly contracted specimens, the posterior margin is more or less incised behind the pedicel of the posterior sucker. Specimens which have been flattened under pressure during fixation have the posterior margin entire, or but slightly emarginate. The pharynx is usually broader than long. In 24 specimens examined, 3 were found in

which the length and breadth of the pharynx were about the same. In the others the breadth was greater than the length, the average for 2 specimens being: Length, 0.79 mm.; breadth, 1.03 mm.

The diameter of the posterior sucker is exclusive of the frilled border, which is somewhat evanescent. The anterior suckers are more or less crumpled, and the breadth could not be measured satisfactorily. The posterior sucker is usually nearly circular.

I have a record in my notes of the finding of what was thought to be this species on two occasions on the gills of the spearfish (*Istiophorus americanus*):

Several specimens collected on August 17, 1913, by Dr. MacCallum.

Three collected on July 23, 1924. The largest measured 10 mm. in length and 6.5 mm. in breadth; the smallest, length 8 mm., breadth 6.5 mm.; diameter of posterior sucker, 3.5 mm.; margins crenulate, dorsal surface with numerous small papillae; color translucent white. These specimens were turned over to Dr. MacCallum.

TABLE 2.—Measurements of six specimens of *Tristoma papillosum* in balsam

| Measurement | 1 | 2 | 3 | 4 | 5 | 6 |
|-----------------------------------|------------|------------|------------|------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 4.00 | 6.00 | 7.00 | 10.00 | 11.00 | 13.00 |
| Breadth..... | 2.00 | 7.00 | 4.00 | 7.00 | 8.00 | 9.00 |
| Anterior sucker, length..... | .80 | 1.20 | .91 | 1.20 | 1.20 | ..... |
| Diameter of posterior sucker..... | .91 | 1.61 | 1.12 | 1.75 | 1.96 | 2.24 |
| Pharynx, length..... | .63 | .77 | .56 | .77 | 1.12 | 1.40 |
| Pharynx, breadth..... | .56 | 1.00 | .67 | 1.20 | 1.33 | 1.54 |

TRISTOMA COCCINEUM Cuvier

PLATE 14, FIGURES 175-179

Associated with the tristomes from the gills of the swordfish (*Xiphias gladius*) in the collection, referred to *T. papillosum*, there are two specimens that differ from the others, particularly in the absence of papillae and in the number and character of the spines on the lateral margins.

The marginal spines are arranged in linear groups at right angles to the margins, each group containing about four spines, and there are approximately 300 groups of spines on one lateral margin (pl. 14, fig. 175). Each spine is flattened, longer than broad, its free end bearing about five short, slender teeth. The length and breadth of the pharynx are about equal. In one of the specimens there was a slight constriction at about the middle of the length of the pharynx. The anterior suckers and the anterior border are crumpled so that exact outlines cannot be made out. There is a shallow emargination at the posterior end. Measurements in balsam: Length, 12.5 mm.;

breadth, 10.2 mm.; longer diameter of anterior suckers about 1.82 mm.; diameter of posterior sucker, exclusive of marginal border, 2.66 mm.; diameter of pharynx, 0.91 mm.; length of spines on posterior sucker, 0.13 and 0.15 mm.; breadth, 0.02 mm. (U.S.N.M. No. 8151).

On the right margin of one of the specimens, near the middle of the length, there is a spinelike structure, bearing on its ventral surface, near the tip, four stout, sharp-pointed, chitinous hooks (pl. 14, figs. 175, 176). There are two similar hooks on the dorsal side, not shown in the figures. Length of spine about 9.42 mm.; diameter at inner end about 0.11 mm., near tip 0.04 mm. This structure cannot be made out on the other specimen, which is much crumpled.

Genus CAPSALA Bosc, 1811

CAPSALA MOLAE (Blanchard)

PLATE 15, FIGURES 180-183

Tristomum rudolphianum Diesing, LINTON, Proc. U. S. Nat. Mus., vol. 20, p. 510, 1898; Bull. U. S. Fish Comm. for 1899, p. 281, 1900.

Tristomum molae Blanchard, LINTON, Bull. U. S. Fish Comm. for 1899, p. 466, 1901.

Host.—Sunfish (*Mola mola*).

Record of collections.—One, collected by Vinal N. Edwards, August 1, 1894. Dimensions in alcohol: Length 23 mm., breadth 24 mm., diameter of posterior sucker 16 mm. Location on host not noted on label.

Six (U.S.N.M. No. 8152), collected July 20, 1914, from skin of host; largest 25 mm. in diameter.

One, collected by Robert Goffin, September 3, 1925, from skin.

Eleven (U.S.N.M. No. 8153), collected July 19, 1926, from skin. These were turned over to Dr. MacCallum.

TABLE 3.—*Measurements of three specimens of Capsala molae in balsam*

| Measurement | 1 | 2 | 3 |
|---|------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 5.00 | 10.00 | 15.00 |
| Breadth..... | 4.50 | 9.50 | 14.50 |
| Anterior sucker, length..... | .80 | 1.12 | 1.54 |
| Anterior sucker, breadth..... | .74 | .84 | 1.12 |
| Posterior sucker, length..... | 1.64 | 4.00 | 5.00 |
| Posterior sucker, breadth..... | 1.24 | 5.00 | 6.00 |
| Pharynx, length..... | .77 | 1.26 | 2.03 |
| Pharynx, breadth..... | .70 | 1.12 | 1.75 |
| Pharynx, anterior division, length..... | .49 | .77 | 1.12 |
| Pharynx, anterior division, breadth..... | .70 | 1.12 | 1.75 |
| Pharynx, posterior division, length..... | .28 | .49 | .91 |
| Pharynx, posterior division, breadth..... | .56 | .92 | 1.56 |

CAPSALA LAEVIS (Verrill)

PLATE 15, FIGURES 184-188

Tristoma laeve VERRILL, Amer. Journ. Sci. and Arts, ser. 3, vol. 10, p. 40, 1875.

While a lot of alcoholic material from the gills of swordfish (*Xiphias gladius*) were being examined, a single specimen (U.S.N.M. No. 8154) of the genus *Capsala* was found. The date of collecting is not certain. It was probably in the lot collected on July 13, 1911, when about 75 tristomes were taken from the gills of a swordfish.

Measurements in balsam: Length, 11.25 mm.; breadth, 8.5 mm.; anterior suckers, length 2.1 mm., breadth 1.65 mm.; posterior sucker, length 3.78 mm., breadth 3.42 mm.; hooks on posterior sucker, length 0.45 mm., breadth 0.17 mm.; pharynx, length 1.4 mm., breadth 1.45 mm.

There are two stout, blunt hooks on the posterior sucker. The length given above is a little less than the actual length, since the hooks were slightly inclined to the plane of the slide, and consequently foreshortened in the camera lucida sketch. The pharynx is divided into an anterior and a posterior portion by a constriction a little back of the middle. Length of anterior portion, 0.84 mm.; breadth, 1.45 mm.; length of posterior portion, 0.56 mm.; breadth 0.91 mm.

The posterior sucker has five rays on its anterior half. The intestines are profoundly branched, the ultimate branches reaching nearly to the margins of the body and extending into the anterior suckers and into the anterior lobe between the suckers, in all of which branches of the intestines reach nearly to the margin. The cirrus pouch, enclosing the seminal vesicle at its base, reaches quite to the median line immediately behind the pharynx. The two testes lie side by side a short distance back of the cirrus pouch to the left of the median line. They are somewhat obscured by the branches of the intestine. The vas deferens makes a loop from the testes to a point a short distance to the right of the median line, returning in front of the testes, whence it becomes crumpled into short folds, then proceeds to the cirrus pouch, which it enters at about the middle of the length. The ovary is a rosettelike cluster of 12 or more lobed bodies on the median line, its left anterior border being contiguous with the right testis. The vitellaria have about the same distribution as the intestines, extending nearly to the margins, including the anterior suckers and the anterior lobe between the suckers. Two nerve trunks on each side lateral to the main intestinal rami, and connected at the level of the cirrus pouch by broad commissures, are clearly shown.

There are about 38 small tubercular spines on each lateral margin, beginning a short distance from the anterior suckers and extending to the posterior sucker. They are short, tending to pyramidal in shape, and are surmounted by three short tines. No eye spots were seen. There is a membranous border to both anterior and posterior suckers.

Suborder POLYOPISTHOCOTYLEA Odhner, 1912

Family ONCHOCOTYLIDAE Monticelli, 1903

Genus ONCHOCOTYLE Diesing, 1850

ONCHOCOTYLE MAVORI, new species

PLATE 15, FIGURES 189-196

The specimens here described were given to me by Dr. James W. Mavor, who had found them on the bottom of an aquarium in which were a number of white perch (*Morone americana*), from Tashmoo Pond, Marthas Vineyard, Mass.

Since these trematodes were not found on the gills of the perch, and since the genus *Onchocotyle* has been recorded only from the gills of selachians, there is naturally some doubt as to the perch being their host.

The following description is based mainly on a study of whole mounts in balsam:

The body proper is somewhat lanceolate, tapering more anteriorly than posteriorly. Anterior sucker nearly terminal, sharply marked off from the body by a constriction. The posterior sucker-bearing portion is approximately half the length of the body proper, and usually nearly at right angles to it. At the anterior ventral half of the sucker-bearing portion there are three pairs of relatively large circular suckers, equal in size and sessile. Each of these suckers is supported by a strong, sickle-shaped chitinous hook, the posterior end of which is blunt while the anterior end terminates in a slender, recurved claw. The hook agrees closely with Olsson's figure of the corresponding hook in *O. emarginata*.⁴ The posterior half of the sucker-bearing portion tapers gently to a blunt, bifid termination, consisting of two small terminal suckers, longer than broad, and opening posteriorly. On the median line between the bases of these terminal suckers there is a pair of small hooks, which appear narrow in dorsoventral view but in lateral view are seen to have relatively broad bases, from which they taper to sharp-pointed and recurved ends. The genital pore is on the median line a short distance back

⁴ Kongl. Svenska Vetensk. Akad. Handl., ser. 2, vol. 14, No. 1, pl. 2, fig. 26, 1876.

of the anterior sucker and close behind the bifurcation of the intestine. The pharynx is relatively small, about as broad as long. It was not clearly shown in the whole mounts; in sections the length was 0.075 mm., breadth, 0.06 mm. There appears to be a short esophagus in some of the mounted specimens, while in others it is indistinguishable. The intestines could not be traced in whole mounts, but in sections the two rami are seen to unite at the end of the body proper, and to continue as a single tube in the posterior sucker-bearing portion. The cirrus is dorsal to the anterior end of the uterus and enters the genital cloaca in front of the uterus. The testes are numerous and occupy the midregion of the posterior third of the body proper behind the ovary. The vas deferens is dorsal to the uterus. The ovary, at the center of the body, is longer than broad on right of median line and appears to be slightly lobed on its lateral margin. It was not clearly outlined in any of the mounted specimens. The vitelline reservoir is conspicuous. It is ventrally placed and is somewhat triangular in outline. It receives a duct from each side at its anterior angles and sends a short duct to the shell gland from its posterior angle. The vitellaria are diffuse and fill the lateral regions of the body from a little way back of the level of the genital pore and in large degree conceal the other genitalia. They extend into the sucker-bearing portion nearly to the terminal suckers. The uterus passes forward on the ventral side of the vas deferens to the genital pore. Ova were present in the uterus of each of the six mounted specimens, from 4 to 37, with an average of about 18. They are more or less oval-elliptical in outline with an elongated filament at each end; about 0.13 by 0.53 mm., exclusive of filaments. The division between the right and left vitellaria is narrow in front of the space occupied by the ovary, shell gland, and vitelline reservoir. The vitellaria overlap the testes and part of the ovary.

TABLE 4.—Measurements of six specimens of *Onchocotyle mavori* in balsam

| Measurement | 1 | 2 | 3 | 4 | 5 | 6 |
|---|------------|------------|------------|------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length of body proper..... | 4.83 | 4.69 | 4.55 | 4.42 | 4.34 | 3.78 |
| Length of sucker-bearing portion..... | 2.10 | 2.10 | 2.17 | 2.81 | 2.45 | 2.10 |
| Diameter anterior sucker..... | .35 | .35 | .38 | .38 | .36 | .35 |
| Maximum diameter of body..... | 1.12 | 1.08 | 1.06 | .92 | .84 | .68 |
| Diameter larger posterior suckers..... | .45 | .42 | .42 | .42 | .49 | .35 |
| Posterior terminal sucker, length..... | .21 | .21 | .22 | .21 | .21 | .21 |
| Posterior terminal sucker, breadth..... | .14 | .14 | .14 | .10 | .14 | .14 |

A specimen in glycerin measured 5 mm. in length, 1.14 mm. in maximum breadth; breadth of anterior sucker, 0.42 mm.; diameter of pharynx, 0.09 mm. Measurements of specimen in alcohol: Length,

10 mm.; length of sucker-bearing portion, 3 mm.; diameter of anterior sucker, 0.38 mm.; maximum diameter of body, 0.81 mm.; diameter of one of the larger pair of suckers, 0.42 mm.; one of posterior terminal suckers, length 0.25 mm., breadth 0.14 mm.

Type specimens.—Holotype, U.S.N.M. No. 8155; paratypes, No. 8412.

Family DICLIDOPHORIDAE Fuhrmann, 1928

Genus DICLIDOPHORA Diesing, 1850

DICLIDOPHORA AFFINIS (Linton)

Octoplectanum affine LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 511, 512, pl. 51, figs. 1-5, 1898.

Diclidophora affinis (LINTON), Bull. U. S. Fish Comm. for 1899, p. 482, 1901.

Three specimens of this species (U.S.N.M. No. 8156) were collected in the summer of 1905 from the mouth of the summer flounder (*Paralichthys dentatus*) by Dr. J. F. McClendon.

DICLIDOPHORA PINGUIS, new species

PLATE 15, FIGURES 197-199

The trematodes here described were taken from the mouth of *Albatrossia pectoralis* in the northwest Pacific, June 7, 1906; U. S. Bureau of Fisheries steamer *Albatross*, station 4781, depth 482 fathoms.

Ten specimens were given to me by Willis H. Rich at the Bureau of Fisheries Laboratory, Woods Hole, Mass., in the summer of 1925. Measurements in alcohol: Length of body, 4 mm.; of sucker-bearing portion, about 3 mm.; breadth at level of anterior suckers, 0.56 mm., maximum, middle of body, 2.1 mm.; anterior suckers, length, 0.35 mm., breadth, 0.25 mm.; pharynx, length, 0.46 mm., breadth, 0.42 mm. In another specimen the breadth at level of anterior suckers was 0.45 mm.; anterior suckers, length, 0.28 mm., breadth, 0.21 mm.; pharynx, length, 0.42 mm., breadth, 0.35 mm. Dimensions of a posterior sucker in glycerin: Length of pedicel, 0.42 mm., diameter, 0.46 mm.; maximum diameter of sucker, 1.4 mm.

The alcoholic specimens agree in having a short, narrow anterior portion, which is sharply marked off from the body, necklike, nearly cylindrical, tapering but slightly to the anterior end. The body proper is stout and oblong-elliptical in outline. Sections show it to be very muscular. It is doubtless capable of much elongation. The mouth appears to be terminal; anterior suckers oval-elliptical; pharynx relatively large, its anterior edge lying at the posterior edges of the anterior suckers, its posterior end about on a level with the con-

striction, which marks off the anterior portion from the body proper. The esophagus is short. The intestinal rami appear to continue to near the posterior end of the sucker-bearing portion. The genital atrium is close behind the forking of the intestine, and appears to lie a little to one side of the median line. It is surrounded by strong muscles, but no hooks were seen either in whole mounts or in sections. The breadth of the muscular atrium in cross sections is 0.15 mm., its vertical diameter, 0.08 mm. The ovary, with its spacious portion containing large nucleated germ cells, lies a short distance behind the genital atrium. The shell gland is dorsally placed. The vitellaria begin at the level of the posterior end of the pharynx and extend to the posterior end of the body proper. The testes are numerous and fill a wide median space between the ovary and a point near the posterior end of the body. The sucker-bearing portion bears eight relatively large, pedicelled suckers, arranged symmetrically, four on each side. The suckers are supported by a chitinous frame work which forms a cross, characteristic of the genus *Diclidophora*.

Type specimens.—Holotype, U.S.N.M. No. 8157; paratypes, No. 8158.

Family DISCOCOTYLIDAE Price, 1936

Genus ANTHOCOTYLE van Beneden and Hesse, 1863

ANTHOCOTYLE MERLUCCII AMERICANUS MacCallum

PLATE 16, FIGURES 200, 201

Anthocotyle merluccii americanus MACCALLUM, Zoopathologica, vol. 1, pp. 25-27, figs. 10, 10A, 1918.

I find one specimen of this species in my collection, from gills of the whiting (*Merluccius bilinearis*), collected July 2, 1924. Length, life, 8 mm. (U.S.N.M. No. 8191).

Measurements in balsam: Length, 7.5 mm.; maximum breadth, at level of ovary, 1.26 mm.; diameter anterior suckers, 0.07 mm.; pharynx, length 0.08 mm., breadth 0.07 mm.; larger posterior suckers, left, length 0.52 mm., breadth 0.63 mm.; right, length 0.45 mm., breadth 0.52 mm.; smaller posterior suckers, length 0.06 mm., breadth 0.08 mm.; length of terminal spines 0.06 mm.

Some points of difference between this specimen and those studied by Dr. MacCallum were noted. Thus, the left of the larger posterior suckers are the larger instead of the right. The terminal hooklets are not of uniform size and shape. There are also paired vaginae (pl. 16, fig. 200).

Family HEXASTOMATIDAE Price, 1936

Genus HEXOSTOMA Rafinesque, 1815

HEXOSTOMA THYNNI (De la Roche)

Hexacotyle thynni (De la Roche), LINTON, Bull. U. S. Fish Comm. for 1899, p. 446, figs. 296–298, 1901.

Record is here made of one specimen of this species, collected August 21, 1900, by Dr. C. B. Wilson from the mouth of the bonito (*Sarda sarda*).

Dimensions in life: Length 5 mm., breadth 1.5 mm. Color faint red. When compressed under cover glass a mass of globular bodies of different sizes was extruded from the excretory pore.

Family MAZOCRAEIDAE Price, 1936

Genus MAZOCRAEOIDES Price, 1936

MAZOCRAEOIDES GEORGEI Price, 1936

PLATE 16, FIGURES 202–209

Mazocraeoides georgei PRICE, George Washington Univ. Bull. (Summaries of Doctoral Theses, 1934–36), p. 13, 1936.

Body, at rest and in preserved material, lanceolate; in life, capable of great alterations of length and breadth, usually slightly pointed in front of anterior suckers. Posterior third of body, more or less, with four suckers on each side; suckers with chitinous frames, and pedicels, which are very flexible in life, extending to a length nearly equal to half the breadth of the body and contracting until the chitinous portion is immersed in the substance of the body. In preserved material the pedicels of the posterior suckers are short. There is a cluster of six hooks at the posterior end, one larger pair, and two smaller pairs between the larger. Pharynx elliptical, longer than broad, near anterior suckers; esophagus as long as or longer than pharynx; rami of intestine much branched, but concealed by the vitellaria; genital sucker armed with short, recurved spines, a short distance back of forking of intestine. The single testis is in the posterior third, on the left side of the median line, and is deeply lobed on the lateral margin. The ovary, including germ-containing portion, lies on the right side of the median line parallel with the testis, extending a little farther anteriorly than the testis, but not quite so far posteriorly. The anterior portion, the ovary proper, is compact, the posterior, more elongated portion contains large, nucleated germ cells. The vitellaria are very voluminous and extend in broad lateral masses from a short distance behind the genital

sucker to the posterior end, where the lateral masses meet behind the testis. There is a vitelline reservoir on the median line in front of the level of the ovary. It is somewhat variable in shape and position, depending on the quantity of yolk. What was interpreted to be a seminal receptacle was seen in a few cases in front of the ovary. The shell gland and ootype are about on the median line on a level with the anterior portion of the ovary. The ova are elongate, with a filament at each end.

Measurements in balsam: Length, 2 mm.; breadth, at level of anterior suckers, 0.07 mm., in front of sucker-bearing portion, about 0.75 mm.; diameter of anterior sucker, 0.027 mm.; pharynx, length 0.045 mm., breadth, 0.027 mm.; ova diameter, 0.06 mm.; length, exclusive of filaments, about 0.26 mm.

Hosts.—Alewife (*Pomolobus pseudoharengus*) and hickory shad (*P. mediocris*).

Record of collections.—Five (U.S.N.M. No. 8159), collected August 11, 1908, from gills of alewife. Rami of intestines of most of them bright red; numerous minute black pigment spots in lateral areas. These worms were very active, contracting to a length of 0.6 mm. and stretching to a length of 1.8 mm.; posterior suckers, four on each side on very flexible and contractile pedicels, extending to more than half the breadth of the posterior half of the body, and contracting until no pedicel could be seen, the sucker even becoming immersed in the substance of the body; six slender hooks at the posterior end of the body, the part where they are implanted being very contractile, the hooks being so arranged as to have a grasping motion; worms fragile.

Number not recorded, collected July 8, 1910, on gills of alewife. Color by reflected light white, with numerous small brown pigment granules; margins and anterior end translucent, by transmitted light the axial region also translucent and somewhat yellowish. In a few cases the intestines were red. Body crossed by fine, crinkly lines with short, twiglike branchings.

Many, collected on August 17, 1910, on gills of a 22-cm. alewife. This worm has extraordinary powers of extension and contraction, especially of the part anterior to the sucker-bearing portion. The anterior end may be extended into a fine, threadlike neck, or it may be contracted so that the whole worm is as broad as it is long. These changes take place very rapidly.

One, collected August 20, 1910, from gills of hickory shad.

One, collected July 6, 1912. After this date no special search was made for gill parasites, since about this time the study of the monogenetic trematodes was taken up by Dr. MacCallum.

Genus **PLEUROCOTYLE** Gervais and van Beneden, 1859**PLEUROCOTYLE SCOMBRI** (Gervais and van Beneden)

PLATE 16, FIGURES 210-214

See STILES and HASSALL, U. S. Hyg. Lab. Bull. 37, p. 346, 1908, for references.

A trematode from the gills of the chub mackerel (*Pneumatophorus grex*), collected August 9, 1908, is referred to this species (U.S.N.M. No. 8160).

The worm is divided by a constriction into two parts, an anterior lanceolate and a posterior clavate portion. The posterior portion carries four conspicuous suckers, from 0.2 to 0.4 mm. in diameter, in a longitudinal row. The first three suckers are longer than broad, the fourth is broader than long. Behind the fourth sucker there is a fifth minute sucker, about 0.04 mm. in diameter. It lies 0.15 mm. behind the fourth sucker, and about 0.03 mm. from the posterior margin of the sucker-bearing portion. The two suckers at the anterior end are longer than broad, the pharynx is at their posterior edges, and there is a relatively long esophagus. The intestine is profusely branched, the branches beginning in front of the point of forking. The intestines continue into the posterior, sucker-bearing portion. The genital cloaca is about halfway between the pharynx and the forking of the intestine. It is armed with a cluster of hooks, which were somewhat broken and disturbed. These hooks appear to have a large basal portion terminating at the anterior end in a small, recurved claw. The basal portions together form an oval-elliptical structure about 0.08 mm. in length and 0.05 mm. in diameter. The ovary lies near the right side of the median line, 1.26 mm. in front of the constriction; testes confined to narrow median space, about 1 mm. in length, behind the ovary. The vitellaria begin a short distance back of the forking of the intestine and extend into the sucker-bearing portion, filling the body and obscuring the other genitalia. The follicles are somewhat interrupted in the vicinity of the suckers but they continue on both sides to the posterior end.

Dimensions in balsam: Length, 7.84 mm.; breadth, anterior 0.16 mm., middle 1.47 mm., near posterior end 1.26 mm.; anterior suckers, length 0.09 mm., breadth 0.05 mm.; pharynx, length 0.09 mm., breadth 0.084 mm.; length of sucker-bearing portion, 2.38 mm.; breadth, at constriction, 0.7 mm., middle, and to near posterior end, 1.26 mm.; first three posterior suckers, each, length 0.42 mm., breadth 0.23 mm.; fourth posterior sucker, length 0.21 mm., breadth 0.3 mm.; minute terminal sucker, diameter about 0.04 mm.

Family MICROCOTYLIDAE Taschenberg, 1879

Genus MICROCOTYLE van Beneden and Hesse, 1863

MICROCOTYLE CARANGIS MacCallum

Microcotyle carangis MACCALLUM, Zool. Jahrb., vol. 35, pp. 394-396, fig. B, 1913.

Six trematodes, collected on July 19, 1912, from the gills of the hardtail (*Paratractus crysos*), agree with the description of this species.

MICROCOTYLE PORONOTI MacCallum

PLATE 16, FIGURE 215

Microcotyle poronoti MACCALLUM, Zool. Jahrb., vol. 38, pp. 72, 73, 75, fig. B, 1915.

Host.—Dollarfish (*Poronotus triacanthus*).

Record of collections.—One, collected July 2, 1907, from gills of host. One (U.S.N.M. No. 8161), collected July 11, 1910, length 4 mm., from gills. One, collected July 19, 1910, from gills.

These trematodes agree closely with the descriptions of this species. In these specimens, however, the anterior suckers are biloculate, a character not noted in *M. poronoti*. In the two specimens mounted in balsam, one has a distinct costa in each of the anterior suckers; in the other the costae are indistinct.

Dimensions in balsam: Length 5 mm.; breadth, at level of anterior suckers, 0.22 mm., maximum 0.63 mm.; anterior sucker, length 0.07 mm., breadth 0.1 mm.; pharynx, length 0.045 mm.; breadth 0.045 mm.; posterior sucker about 0.054 by 0.09 mm. The length of the sucker-bearing portion is approximately 1.6 mm.

MICROCOTYLE POMATOMI Goto

PLATE 16, FIGURES 216-218

Microcotyle pomatomi GOTO, Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 12, pp. 278, 279, fig. 27, 1899.

Microcotyle sp. LINTON, Bull. U. S. Fish Comm. for 1899, p. 451, figs. 299-306, 1901.

Linear-lanceolate; posterior sucker-bearing portion, and middle region of anterior portion colorless or translucent white; margins, including vitellaria, with numerous small black pigment spots. The number of posterior suckers appears to be 90 to 100 on each side. Goto gives the number as about 70. Genital atrium spacious, armed with numerous small recurved hooks. The ovary consists of two portions: a small, compact, many-lobed portion, situated ventrally, on the median line, and a larger and much convoluted portion, containing large germ cells, which, beginning at the right dorsal border of

the compact portion, pursues a somewhat tortuous course, crossing to the left side of the median line, then passing forward and crossing to the right side, and returning on the right side of the median line to the shell gland, which lies in front of the ovary. There it is joined by the vitelline duct and the duct from the seminal receptacle. There appears to be some variation in the course of the later folds of the ovary, but, in general, it is much as in the one shown in the sketch (pl. 16, fig. 217). There is also some variation in the outlines of the compact portion of the ovary, but in all it is lobed and broader than long.

Testes about 50, many of them irregularly lobed.

The suckers near the tip of the sucker-bearing portion are distinctly in two rows, but near the body proper they do not appear to be distinctly in two rows, even in some cases appearing to be in four or more irregular rows. This irregularity is more or less the result of compression.

TABLE 5.—Measurements of three specimens of *Microtyle pomatomi* in balsam

| Measurement | 1 | 2 | 3 |
|--|------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 8.00 | 7.14 | 5.63 |
| Length of sucker-bearing portion..... | 3.00 | 2.80 | 2.53 |
| Breadth, at level of anterior suckers..... | .20 | .19 | .18 |
| Breadth, maximum..... | 1.33 | 1.47 | 1.36 |
| Anterior sucker, length..... | .06 | .06 | .06 |
| Anterior sucker, breadth..... | .07 | .07 | .07 |
| Pharynx, length..... | .06 | .06 | .06 |
| Pharynx, breadth..... | .04 | .05 | .04 |

Ova, exclusive of filaments, 0.17 by 0.05 mm., to 0.24 by 0.08 mm. Posterior suckers about 0.06 by 0.07 mm.

Host.—Bluefish (*Pomatomus saltatrix*).

Record of collections.—Fifteen (U.S.N.M. No. 8162), collected August 11, 1904, from gills of host.

Twenty-six, collected July 1, 1910, from gills of host. Measurements, life: Length, 7.5 mm.; length of sucker-bearing portion, 2.5 mm.; maximum breadth, 2 mm.

MICROCOTYLE STENOTOMI Goto

PLATE 16, FIGURE 219

Microcotyle stenotomi Goto, Journ. Coll. Sci. Imp. Univ. Tokyo, vol. 12, pp. 279–281, pl. 21, fig. 28, 1899.—G. A. and W. G. MacCALLUM, Zool. Jahrb., vol. 34, pp. 230, 231, 1913.

This species is probably of frequent occurrence. I have the following records for it:

Host.—Southern porgy (*Stenotomus chrysops*).

Record of collections.—Two (U.S.N.M. No. 8163), collected August 24, 1910, from gills of host; 6 fishes examined. Two, collected August 27, 1910, from gills; 3 fishes examined. Three, collected August 29, 1910, from gills; 16 fishes examined. One, collected August 30, 1910, from gills; 3 fishes examined.

Measurements in balsam: Length of body proper, 2.94 mm., of sucker-bearing portion, 0.98 mm.; breadth, at anterior end, 0.17 mm., middle, 0.45 mm.; anterior sucker, length, 0.09 mm., breadth, 0.06 mm.; posterior sucker, 0.036 by 0.045 mm.; pharynx, length, 0.036 mm., breadth, 0.03 mm.; egg, exclusive of filaments, 0.21 by 0.56 mm. Number of testes 12; number of posterior suckers about 48.

MICROCOTYLE FURCATA, new species

PLATE 16, FIGURE 220; PLATE 17, FIGURES 221-223

Body lanceolate, tapering to a blunt point at anterior end; sucker-bearing portion approximately half the length of the body proper, and bearing from 20 to 28 suckers on each side; pharynx nearly circular in outline; esophagus short. The intestines were hidden in large part by the vitellaria. So far as could be seen the main intestinal branches do not extend posterior to the vitellaria. The genital atrium is spacious and armed with numerous short, somewhat conical spines, the greater number of them about 0.006 mm. in length, but a few at the posterior border of the atrium are about 0.009 mm. in length. Ovary, as noted in other species of the genus, of two distinct portions: (1) The ovary proper, consisting of small, closely packed cells, on the right side of the median line at the anterior edges of the first testes; broader than long, and in some cases slightly lobed. Its inner end is about on the median line, whence it extends to the inner border of the right vitellaria. (2) An elongated and more or less convoluted portion, containing large nucleated germ cells. It is somewhat variable, but in general it may be described as a tubular, greatly enlarged germ duct (pl. 17, fig. 222). It leaves the anterior dorsal side of the ovary proper, passes forward dorsal to the shell gland near the median line, turns, and crosses the median line. It may then turn and run back for a short distance, turn again, and return on itself, and run parallel to its former course, thus forming a more or less horseshoe-shaped structure, with the closed end pointing forward. It ends in front of the ovary proper where it narrows to form the germ duct, which is joined, first, by the short duct from the seminal receptacle, which lies near the anterior border of the ovary proper, and then a little farther by the vitelline duct. It then enters the region of the shell gland, from

which it emerges as the uterus to pass along the median line ventral to the vas deferens to the genital atrium. Testes from 14 to 24. In the seven specimens mounted in balsam one has 14 testes, four have 15 each, one 16, and one about 24. They extend from the posterior edge of the ovary to a point a little in front of the posterior end of the vitellaria. The vitellaria begin a short distance back of the level of the genital atrium and continue in a broad band on each lateral margin to unite behind the testes. A few follicles continue into the sucker-bearing portion. Y-shaped yolk ducts are a conspicuous feature in most cases. In some of them these ducts expand into capacious yolk reservoirs. They originate, one on each side a little in front of the middle, and unite in a common duct on the median line a short distance in front of the ovary proper.

Measurements in balsam: Length of body proper 2.1 mm., of sucker-bearing portion 1.7 mm., breadth at level of anterior suckers 0.14 mm., at level of genital atrium 0.35 mm., at level of ovary 0.81 mm.; anterior sucker, length 0.045 mm., breadth 0.06 mm.; pharynx, length 0.045 mm., breadth 0.039 mm. (in another specimen length, 0.045 mm., breadth, 0.045 mm.); posterior sucker, 0.075 by 0.045 mm. Smallest number of suckers counted on one side 20, largest number noted 28; one was noted that had 28 suckers on one side and 24 on the other.

Type specimen.—Holotype, U.S.N.M. No. 8164.

Host.—Tautog (*Tautoga onitis*).

Record of collections.—One, collected August 15, 1908, from gills of host; length, 3 mm., breadth, 0.5 mm.; 42 suckers on sucker-bearing portion.

Many, collected July 9, 1910, from gills; color white, except in vicinity of vitellaria. In some cases the intestine was red by reflected, yellowish by transmitted, light. Length, 4 mm., more or less.

Three, collected August 3, 1910, on gills.

Few, collected August 10, 1910, on gills.

One (U.S.N.M. No. 8164), collected by Vinal N. Edwards, May 4, 1914, from gills; length, 4.25 mm.

MICROCOTYLE SPINICIRRUS MacCallum

Microcotyle spinicirrus MACCALLUM, Zoopathologica, vol. 1, No. 3, p. 95, fig. 50, 1918.

Host.—Fresh-water drum (*Aplodinotus grunniens*).

Record of collection.—A small number of these trematodes (U.S.N.M. No. 8165), collected by T. Serbes, Fairport, Iowa, and sent to me by Dr. R. E. Coker, were received on July 23, 1913. They agree in general with Dr. MacCallum's description of the species.

Measurements in balsam: Length, 2.8 mm.; maximum breadth, 0.5 mm.; length of sucker-bearing portion, 1.3 mm.; anterior suckers, length, 0.07 mm., breadth, 0.033 mm.; pharynx, length, 0.075 mm., breadth, 0.048 mm.; diameter of circle of hooks at genital pore, 0.1 mm.; length of hooks, about 0.04 mm.; diameter of cluster of cirrus hooks, 0.05 mm.; length of hooks, 0.036 mm.; length of a posterior sucker about 0.06 mm., breadth about 0.08 mm.; length of ovum, exclusive of filaments, 0.24 mm., diameter, 0.07 mm. The number of posterior suckers was about 50 on each side.

MICROCOTYLE species

PLATE 17, FIGURES 224-227

Two specimens from the gills of the squeteague (*Cynoscion regalis*) are here noted. The species differs from *M. longicauda* Goto, from the same host, in the number of caudal suckers, the number of testes, and in the character of the genital atrium.

The collection consists of a single mounted specimen.

Record of collections.—One, collected August 9, 1903. It was accidentally crushed while it was under examination. Hooks of the genital atrium of three kinds. Plate 17, figure 226, was sketched from the crushed specimen. Ova fusiform, with filament at one end.

One (U.S.N.M. No. 8166), collected August 22, 1914. This specimen, slightly damaged, is mounted in balsam. The number of testes is about 20. The ovary is lobed. The portion containing ripe germ cells forms a horseshoe-shaped loop with the open end toward the posterior end. The vitellaria extend into the sucker-bearing portion.

Measurements in balsam: Length, 4.5 mm.; breadth, at level of anterior suckers, 0.2 mm., at level of ovary 0.9 mm.; length of sucker-bearing portion about 2.3 mm.; anterior sucker, length, 0.09 mm., breadth, 0.06 mm.; pharynx, length, 0.08 mm., breadth, 0.05 mm.; posterior suckers, 0.07 by 0.05 mm.; about 70 suckers on each side.

Genus AXINE Abilgaard, 1794

AXINE GRACILIS, new species

PLATE 17, FIGURES 228-230

The collection contains three specimens, mounted in balsam: two adults, one of which lacks the greater part of the region back of the ovary, and one young specimen.

These worms are slender and of nearly uniform breadth throughout the greater part of the length, tapering slightly near the anterior

end, which is characterized by having a shallow notch with irregularly scalloped outline at the extreme anterior tip in front of the somewhat diagonally placed anterior suckers. The posterior end is expanded into a trumpet-shaped, sucker-bearing portion asymmetrically placed. There are about 60 posterior suckers in the adult specimen and about 50 in the young specimen. The pharynx is small and the esophagus short. The intestines, except near the anterior end, are concealed by the vitellaria. Genital atrium, behind forking of intestine, unarmed. Ovary at about the anterior third of the body, folded upon itself, the two ends pointing forward. In the adult specimen the right and shorter portion of the ovary contains small and much crowded germ cells; the left portion is about twice the length of the right, and contains large germ cells, with thick walls. The seminal receptacle and yolk reservoir lie in front of the left division of the ovary, and the shell gland and ootype at its anteromedian border. The follicles of the vitellaria are rather coarse, and fill the body from near the anterior, to near the posterior end, and from side to side except a narrow region along the median line, in front of and behind the ovary, and the space occupied by the ovary. The testes lie in a linear series, and are confined to a narrow median region reaching from the ovary to within a short distance of the posterior end of the vitellaria. In the adult specimen 20 testes were counted, and in the young specimen 14.

Measurements of adult in balsam: Length, 5.2 mm.; breadth, 0.45 mm.; anterior suckers, length, 0.03 mm.; breadth, 0.04 mm.; anterior end to intestinal rami, 0.18 mm., to vitellaria, 0.7 mm.; posterior end to vitellaria, 0.4 mm.

Type specimens.—Holotype, U.S.N.M. No. 8168; paratypes, No. 8167.

Host.—Garfish (*Strongylura marina*).

Record of collections.—One, collected September 9, 1907, from gills of a 9.5-inch garfish. The process of egg-making was in progress in this specimen. So far as it could be seen it proceeded in the same order as has been observed in *Entobdella bumpusii*.⁵

One, collected August 27, 1910.

One young (U.S.N.M. No. 8167), collected August 30, 1911. Dimensions, balsam: Length, 2 mm., breadth, 0.21 mm., anterior end to vitellaria, 0.4 mm.; anterior suckers, length, 0.03 mm., breadth, 0.036 mm.

One (U.S.N.M. No. 8168), collected September 10, 1912.

⁵ Bull. U. S. Fish Comm. for 1898, pp. 286, 287, 1900; and Biol. Bull., vol. 14, pp. 19-26, 1908.

HETERAXINE, new genus

This trematode agrees with the genus *Microcotyle* in having numerous suckers in two longitudinal rows on the posterior sucker-bearing portion, but differs from that genus in having the suckers of one of the rows fewer and much larger than those in the other row.

Type species.—*Heteraxine cokeri*, new species.

HETERAXINE COKERI, new species**PLATE 17, FIGURES 231-233**

Body stoutish, tapering slightly to a rounded point at the anterior end; posterior sucker-bearing portion with two parallel rows of suckers, the one on the right side containing about 10 large suckers, the one on the left side with 30 or more small suckers. All the suckers are supported by a chitinous framework. Length in balsam, about 5 mm.; breadth, 1 mm. One of the large suckers measured 0.23 mm. in length and 0.35 mm. in breadth; one of the small suckers, length, 0.08 mm., breadth, 0.14 mm. Length of anterior suckers, 0.1 mm., breadth, 0.06; pharynx, length, 0.09 mm., breadth, 0.07 mm.; esophagus very short; genital aperture a short distance back of pharynx, at forking of intestine; retracted cirrus with a fascicle of slender spinelike hooks. These hooks are arranged in two circles, an outer with hooks 0.045 mm. in length and an inner with hooks 0.12 mm. in length. The ovary, as much of it as could be made out, which is the part that contains large, nucleated cells, begins on the left side of the median line, goes forward a short distance, crosses to the outer side, then turns posteriorly, and immediately returns to the median line, or a little to the left of it. Two main vitelline ducts unite in a single short vessel on the ventral side of the ovary. It was not possible to determine the exact number of testes, on account of the irregular shape and lobed character of some of them. The number appeared to be about 30. The vitellaria extend from about the level of the genital opening to near the posterior end of the sucker-bearing portion. An ovum in the uterus measured 0.3 mm. in length, exclusive of the long filament at the anterior end, and 0.08 mm. in diameter; another measured 0.4 by 0.11 mm., exclusive of the anterior filament.

Type specimens.—U.S.N.M. No. 8169 (holotype and paratypes)

Host.—Fresh-water drum (*Aplodinotus grunniens*).

Record of collection.—Two (U.S.N.M. No. 8169) received from Dr. R. E. Coker, Fairport, Iowa, No. 360 Meek Collection, May 2, 1913.

Order DIGenea van Beneden, 1858

Suborder GASTEROSTOMATA Odhner, 1905

Family GASTEROSTOMIDAE Braun, 1883

Subfamily GASTEROSTOMINAE Monticelli, 1892

Genus GASTEROSTOMUM Siebold, 1848

GASTEROSTOMUM ARCUATUM Linton

PLATE 18, FIGURES 234, 235

Gasterostomum arcuatum LINTON, Bull. U. S. Fish Comm. for 1899, pp. 277, 278, 297, 298, figs. 85-90, 1900; *ibid.*, p. 446, 1901; Bull. U. S. Bur. Fish., vol. 24, pp. 363, 365, fig. 235, 1905.

As in other species of the Gasterostomidae, when any considerable number of individuals are examined, much variation in the relative positions of the genitalia is seen. This is due, in large part, to the ova, which often accumulate in enormous numbers. Thus, in the specimen figured it will be noted that the cirrus pouch extends only about halfway from the posterior end to the second testis, whereas it was represented in the original description of the species as extending to the second testis. Also, instead of only about three vitelline follicles on each side behind the level of the ventral sucker, there are in this specimen about twice that number. The number of follicles is, as a rule, 16 on each side. In the specimen figured the number appeared to be 16 on the left side and 15 on the right. The saccular intestine, in uncompressed specimens, seems to extend back to the ventral sucker, but in flattened specimens it may extend both anteriorly and posteriorly, as shown in the figure.

Measurements in balsam: Length, 2.38 mm., breadth, 0.28 mm.; anterior sucker, length, 0.075 mm., breadth, 0.081 mm.; ventral sucker, length, 0.06 mm., breadth, 0.066 mm.; ova, rather thick-shelled, about 0.018 by 0.01 mm.

Hosts.—This species appears to be of frequent occurrence in the bonito (*Sarda sarda*), where it has been found free in the stomach and intestine, also encysted in the pyloric caeca and liver. Other hosts: Common mackerel (*Scomber scombrus*), cutlassfish (*Trichiurus lepturus*), common codfish (*Gadus morrhua*).

Record of collections.—Recorded from the bonito on 19 dates in July and August, in 9 different years, from 1903 to 1928; approximately 1,100 from 15 fishes in July and 500 from 15 fishes in August (U.S.N.M. No. 8170).

On August 20, 1903, yellowish cysts 3 mm. in diameter, more or less, were found on the serous coat of the pyloric ceca of a bonito. Some of the deeper cysts were covered with a silvery coat. Most of the ova from these cysts were about 0.018 by 0.011 mm. There was some variation in size. Thus one ovum measured 0.021 by 0.014 mm. On July 22, 1926, the liver of a bonito, thickly beset with cysts, was brought to me by Dr. Rudolph Bennett. The older cysts were dark brown and filled with waxy, degenerate tissue; others yellow. While examining a piece of the liver two gasterostomes were noted. Later, after teasing portions of the liver, 250 gasterostomes were secured. A cyst, 3 mm. in diameter, was opened and found to be filled with eggs of this gasterostome. It would appear that the worms make their way from the stomach into the liver by way of the bile duct, in the branches of which they remain free for some time. Ultimately they become centers of irritation which are closed off by walls of connective tissue.

Five, collected July 26, 1928, from mackerel; viscera of 12 fishes examined. Measurements in balsam: Length, 1.26 mm.; breadth, 0.18 mm.; diameter of anterior sucker, 0.07 mm., of ventral sucker, 0.04 mm.; anterior end to vitellaria, 0.28 mm., to ventral sucker, 0.38 mm.; ova with thickish shells, 0.015 by 0.009 mm.

Two, collected by Vinal N. Edwards, June 18, 1913, from cutlass-fish. Lengths in formalin, 1.92 and 2.1 mm. The neck is relatively shorter and thicker than it is in specimens from the bonito. In balsam the vitellaria are seen in lateral view and it is difficult to determine their number; 32 were counted in one and 28 in the other. Measurements of larger specimen in balsam: Length, 1.68 mm.; breadth, 0.39 mm.; anterior end to ventral sucker, 0.39 mm.; diameter of anterior sucker, 0.1 mm., of ventral sucker, 0.07 mm.; ova with thickish shells, 0.018 by 0.012 mm.

One (U.S.N.M. No. 8170), collected December 18, 1912, from cod-fish; 10 fishes examined. This specimen, somewhat macerated, is filled with ova, which obscure the anatomy. The cirrus pouch extends to the level of the middle of the second testis. The testes are relatively large, close together, one following the other; the ovary is separated by a short space from the first testis; vitellaria largely concealed by the ova, but appear to extend to the first testis, being represented by granules not aggregated into follicles. Dimensions in balsam: Length, 2.33 mm., breadth, 0.24 mm.; diameter of anterior sucker about 0.08 mm.; ventral sucker, length, 0.07 mm., breadth, 0.06 mm.; anterior end to first folds of uterus, 0.48 mm., to vitellaria, 0.81 mm.; ova somewhat variable in size and outline, about 0.21 by 0.012 mm., shells thickish.

GASTEROSTOMUM CAPITATUM, new species

PLATE 18, FIGURES 236-239

Fusiform, tapering rather more toward anterior than posterior end; densely covered with minute, blunt spines; anterior sucker ventral, preceded by a capitate hoodlike structure, which when fully expanded is much broader than the diameter of the neck at the level of the anterior sucker. Vitellaria 16 or more on each side, separated from the anterior sucker by a space equal to one-fifth or more of the length and extending little, if any, back of the level of the ventral sucker. Ventral sucker a little in front of the middle of the body; intestinal caecum, in uncompressed specimens, posterior to ventral sucker; ovary on right side of intestine; testes on right side, close together, one following the other, the first testis near the ovary. The cirrus pouch extends forward to the level of the second testis. The uterus may fill the greater part of the body back of the vitellaria, but was not observed to extend in front of the vitellaria.

Type specimens.—U.S.N.M. No. 8172 (holotype and paratypes).

TABLE 6.—Measurements of five specimens of *Gasterostomum capitatum* in balsam

| Measurement | 1 | 2 | 3 | 4 | 5 |
|--|------------|------------|------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 1.82 | 1.96 | 1.82 | 1.68 | 1.05 |
| Breadth, of capitate head..... | .17 | .20 | .22 | .22 | .21 |
| Breadth, level of anterior sucker..... | .14 | .17 | .17 | .14 | .15 |
| Breadth, near middle, maximum..... | .67 | .50 | .63 | .43 | .42 |
| Anterior sucker, length..... | .10 | .11 | .11 | .11 | .12 |
| Anterior sucker, breadth..... | .10 | .11 | .11 | .11 | .12 |
| Diameter ventral sucker..... | .06 | .07 | .07 | .07 | .07 |
| Anterior end to vitellaria..... | .55 | .59 | .42 | .38 | .35 |
| Anterior end to ventral sucker..... | .76 | .90 | .73 | .62 | .52 |

Host.—Frigate mackerel (*Auxis rochei*).

Record of collection.—Seventeen (U.S.N.M. No. 8172), collected July 12, 1912. Dimensions, life, compressed: Length, 2.21 mm.; breadth, of capitate anterior end, 0.24 mm., maximum of body, 0.66 mm.; diameter of anterior sucker, 0.21 mm., of ventral sucker, 0.1 mm.; ova, 0.015 by 0.01 mm., shells not thick.

Subfamily PROSORHYNCHINAE Nicoll, 1914

Genus PROSORHYNCHUS Odhner, 1905

PROSORHYNCHUS CRUCIBULUM (Rudolphi)

PLATE 18, FIGURES 240-242

Prosorhynchus crucibulum (Rudolphi), NICOLL, Parasitology, vol. 3, pp. 352-354, fig. 7, 1910.

Two gasterostomes from the conger eel, mounted in balsam, although showing the anatomy incompletely on account of the masses of ova which fill the greater part of the body back of the vitellaria, agree closely with this species as it is described by Nicoll. The body is covered with minute spines and does not vary much in breadth; the breadth at the widest part approximately one-third the length. The anterior sucker is a comparatively large muscular structure, to which Nicoll gives the appropriate name "rhynchus." It tapers to a wedge shape posteriorly and reaches about to the anterior follicles of the vitellaria. The follicles of the vitellaria are irregular in shape, and form an arcuate, transverse cluster in front of the intestinal caecum and anterior folds of the uterus. The ventral sucker is a little back of the middle, and the intestinal caecum is directed forward. In one of the specimens the testes are opposite, the ovary lies at the dorsal border of the right testis, and the cirrus pouch impinges on the posterior edge of the right testis. In the other specimen the testes are crowded to the right side and the cirrus pouch is on the left side, its anterior end about on a level with the left testis, which is at the anteromedian border of the right testis. The ovary is at the anterior border of the right testis, its posterior border also touching the left testis, and its anterior edge on a level with the ventral sucker. The ova have thickish shells, but are somewhat distorted when closely packed together; average size about 0.036 by 0.024 mm.

Host.—Conger eel (*Conger conger*).

TABLE 7.—Measurements of two specimens of *Prosorhynchus crucibulum* in balsam

| Measurement | 1 | 2 |
|-------------------------------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 1.96 | 2.24 |
| Breadth..... | .70 | .70 |
| Anterior sucker, length..... | .30 | .67 |
| Anterior sucker, breadth..... | .28 | .52 |
| Diameter of ventral sucker..... | .18 | .19 |
| Anterior end to vitellaria..... | .38 | .63 |
| Anterior end to ventral sucker..... | 1.12 | 1.12 |

Record of collection.—Two (U.S.N.M. No. 8173), collected September 20, 1912; length in formalin, 3 mm.; breadth, 1 mm.

PROSORHYNCHUS OVATUS (Linton)

PLATE 18, FIGURES 243, 244

Monostomum orbiculare Rudolphi, LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 541, 542, pl. 54, figs. 2-5, 1899.

Gasterostomum ovatum LINTON, Bull. U. S. Fish Comm. for 1899, p. 297, 1900; *ibid.*, p. 457, 1901.

Prosorhynchus ovatus (Linton), DOLLFUS, Fauna des Colonies Françaises, Helmintha, vol. 1, pp. 100-105, figs. 14-17, 1929.

Since earlier descriptions of this species have been lacking in some particulars, the following emended description is given:

Body ovate, depressed, flattened ventrally, convex dorsally, covered with minute spines; broadest as a rule about at the level of the ventral sucker, which is not far from the anterior third; broadly rounded at the anterior end and usually tapering posteriorly to a bluntly rounded point. Anterior sucker subterminal, nearly circular; ventral sucker approximately one-half the diameter of the anterior sucker. The sacculate intestine extends forward from the ventral sucker and gives off a slender cecum from its dorsal side, which extends back about to, or a little beyond, the posterior end of the second testis, its posterior end lying between the second testis and the anterior half of the cirrus-pouch. Testes two, on the right side, somewhat variable in shape, in some cases being longer than broad, in others broader than long, and in yet others circular in outline, close together, usually somewhat diagonally placed. The cirrus pouch lies on the left side of the median line, its anterior end, which encloses the seminal vesicle, extending forward about to the level of the anterior edge of the

TABLE 8.—Measurements of five specimens of *Prosorhynchus ovatus* in balsam. (1 to 4, whole mounts; 5, frontal sections)

| Measurement | 1 | 2 | 3 | 4 | 5 |
|--|------|------|------|------|------|
| | Mm. | Mm. | Mm. | Mm. | Mm. |
| Length..... | 3.15 | 2.84 | 2.52 | 2.24 | 1.68 |
| Breadth, level of anterior sucker..... | .63 | .70 | .63 | .70 | .35 |
| Breadth, level of ventral sucker..... | 1.22 | 1.28 | 1.26 | 1.26 | .63 |
| Breadth, near posterior end..... | .56 | .56 | .49 | .49 | .28 |
| Anterior end to ventral sucker..... | .98 | 1.07 | .95 | .71 | .63 |
| Anterior sucker, length..... | .25 | .25 | .28 | .25 | .16 |
| Anterior sucker, breadth..... | .26 | .24 | .32 | .28 | .20 |
| Diameter of ventral sucker..... | .15 | .15 | .15 | .15 | .12 |
| Ovary, length..... | .24 | .30 | .30 | .21 | .18 |
| Ovary, breadth..... | .21 | .22 | .22 | .16 | .14 |
| First testis, length..... | .49 | .52 | .36 | .28 | .22 |
| First testis, breadth..... | .31 | .42 | .32 | .29 | .18 |
| Second testis, length..... | .60 | .52 | .35 | .32 | .24 |
| Second testis, breadth..... | .28 | .35 | .36 | .32 | .17 |

second testis. Ovary on right side in front of first testis, from which it is separated usually by a space approximately equal to its own diameter, and usually a little in front of the level of the ventral sucker; shell gland at posteromedian border of ovary. The vitellaria are arranged in a somewhat arcuate cluster of follicles on each side from about the level of the ventral sucker to the level of the posterior border of the anterior sucker. The lateral clusters of follicles may or may not meet in the midventral region behind the anterior sucker. The folds of the uterus are widely distributed, and may extend from the posterior end as far forward as the level of the anterior border of the sacculate intestine, or farther. The ova are very numerous; they measure about 0.018 by 0.015 mm. in balsam, and have thickish shells.

Host.—Flasher (*Lobotes surinamensis*).

Record of collections.—Nine (U.S.N.M. No. 8174), collected August 1, 1918.

PROSORHYNCHUS GRACILESCENS (Rudolphi)

PLATE 18, FIGURES 245-249

Gasterostomum sp. LINTON, Bull. U. S. Fish Comm. for 1890, pp. 277, 298, fig. 91, 1900; *ibid.* p. 442, 1901.

Gasterostomum gracilescens Rudolphi, LINTON, Bull. U. S. Bur. Fish., vol. 24, p. 335, figs. 230-232, 1905.—Wagner, TENNENT, Quart. Journ. Micr. Sci., vol. 49, pp. 635-690, pls. 39-42, 1906.

I refer to this species certain gasterostomes of very diverse shape, frequently occurring in the garfish (*Strongylura marina*) and similar forms and found less frequently in the silversides (*Menidia notata*) and other Woods Hole fishes.

These forms vary in size, shape, and relative positions of the genitalia. The body, densely covered with small, scalelike spines, is usually more or less fusiform. The anterior sucker is relatively large and ventrally placed. The anterior end varies from capitate to bluntly and evenly rounded. The ventral sucker is usually a little in front of the middle, but, in strongly contracted specimens, it may be about the middle; it is subglobular and joined to the oval-elliptical, or pyriform, intestinal cecum by a short esophagus. The intestinal cecum is directed toward the anterior end. The cirrus pouch is relatively large, on the left side, its posterior portion thin-walled and more or less coiled in contracted specimens; the anterior portion is thick-walled, and encloses the seminal vesicle at its anterior end. The testes are usually diagonally placed, the second near the right side with the first at its anteromedian edge. They are not far from the middle of the length. They may, however, be crowded into various positions by the accumulating ova. In some cases they may lie, one

behind the other, close to the right side, or nearly opposite each other near the median line. Usually the first testis is behind the level of the ventral sucker, but in some cases it is crowded forward until its posterior edge is on a level with the ventral sucker. The ovary lies in front of the testes, and is usually near or in contact with one or both of the testes. It may be larger or smaller than a testis, or it may be about the same dimensions. Usually the testes are about the same size, circular, oval, subtriangular, to oval-elliptical in outline. The vitellaria, consisting of about 32 follicles, extend across the body from side to side, in some cases a short distance back of the anterior sucker, in others crowded forward so as to overlap the anterior sucker. The follicles extend but a short ways, if at all, along the sides. The uterus is very voluminous and may fill the body from the posterior end to the anterior sucker, thus more or less obscuring the anatomy. The eggs are small, about 0.015 by 0.009 mm. in balsam; shells thin, and usually more or less collapsed. No satisfactory formula can be given to describe the relative positions of the genitalia. For example, the anterior end of the cirrus pouch is, in some cases, about at the level of the posterior edge of the second testis, and therefore far back of the ventral sucker. In other cases the anterior end of the cirrus pouch may be in front of the first testis and in front of the ventral sucker.

In some there is a distinct cap overhanging the anterior sucker (pl. 18, fig. 246). In others the cap is reduced to a buttonlike process, and in still others there is no trace of it. In some, also, the anterior sucker appears to be retracted (pl. 18, fig. 247).

TABLE 9.—Measurements of six specimens of *Prosernynchus gracilescens*, in balsam

| Measurement | 1 | 2 | 3 | 4 | 5 | 6 ¹ |
|----------------------------------|------|------|------|------|------|----------------|
| | Mm. | Mm. | Mm. | Mm. | Mm. | Mm. |
| Length..... | 1.33 | 1.36 | 1.04 | 1.05 | 0.76 | 0.54 |
| Breadth, anterior end..... | .20 | .35 | .32 | .25 | .18 | ..... |
| Breadth, middle..... | .46 | .67 | .60 | .46 | .35 | .45 |
| Breadth, near posterior end..... | .20 | .28 | .28 | .15 | .11 | ..... |
| Anterior sucker, length..... | .18 | .18 | .20 | .16 | .16 | .21 |
| Anterior sucker, breadth..... | .16 | .24 | .24 | .20 | .18 | .20 |
| Diameter of ventral sucker..... | .06 | .07 | .07 | .07 | .06 | ..... |

¹ No. 6, shown in pl. 18, fig. 247, represents an extreme case of contraction.

The above account is based on material from the garfish (*Strongylura marina*).

Hosts.—Silversides (*Menidia notata*), kingfish (*Menticirrhus*), gar (*Strongylura marina*), goggler (*Trachurops crumenophthalma*).

Record of collections.—One, immature, collected August 26, 1904, from silversides. Dimensions, life: Length 1.4 mm.; breadth 0.55

mm.; diameter of anterior sucker 0.21 mm., of posterior sucker 0.09 mm.

Twenty-four (U.S.N.M. No. 8175), collected by Dr. C. W. Hahn, August 8, 1910, from silversides; cysts in flesh behind dorsal fin. Dimensions, life: Length 1.08 mm.; breadth 0.51 mm.; diameter of anterior sucker 0.25 mm., of ventral sucker 0.1 mm. Dimensions in balsam: Length 0.87 mm.; breadth 0.46 mm.; length of anterior sucker 0.15 mm., breadth 0.22 mm.; length of ventral sucker 0.08 mm., breadth 0.09 mm.

Eighteen (U.S.N.M. No. 8176), collected August 27, 1928, from kingfish. These are small, minutely spinose gasterostomes of very diverse shapes. In general they are more or less pyriform, tapering more posteriorly than anteriorly. Anterior suckers relatively large, opening ventrally. In some there is a small buttonlike projection in front of the anterior sucker, as in some of the forms from the gar. The shape depends in part on the condition of the cirrus; when it is everted the posterior third of the body is more or less cylindrical; when the cirrus is retracted the body may be ovate or pyriform. The relative positions of the testes and ovary are subject to some differences depending on the state of contraction, and particularly on their adjustment to the relatively large cirrus pouch. The vitellaria are in front of the other genitalia, except that they may be overlapped by folds of the voluminous uterus. In a typical example there appeared to be about 16 follicles of the vitellaria on each side of the median line forming a continuous band of follicles across the body just behind the anterior sucker. The ova were packed so closely that it was difficult to make satisfactory measurements. They are thin-shelled and about 0.012 by 0.008 mm. to 0.015 by 0.009 mm. in size.

TABLE 10.—Measurements of four specimens of *Proisorhynchus gracilescens* in balsam

| Measurement | 1 | 2 | 3 | 4 |
|---------------------------------|------------|------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 0.57 | 0.66 | 0.78 | 0.81 |
| Breadth..... | .31 | .22 | .29 | .30 |
| Anterior sucker, length..... | .17 | .14 | .15 | .13 |
| Anterior sucker, breadth..... | .17 | .14 | .15 | .17 |
| Diameter of ventral sucker..... | | .08 | | .06 |

Specimens collected from garfish on one date in July, three dates in August, eight dates in September, and one date in October, over a period of seven years during 1907 to 1928. In July, 8 from 1 fish, in August, 45 from 15 fishes, in September, 767 from 11 fishes, in October, 7 from 1 fish. The greatest number obtained from a single fish was 229, on September 9, 1923 (U.S.N.M. Nos. 8177-8178).

One (U.S.N.M. No. 8179), collected September 4, 1911, from goggler; 7 fishes examined. Measurements in balsam, compressed: Length, 1.4 mm.; breadth, 0.56 mm.; ova, 0.015 by 0.009 mm. The anatomy is concealed by the enormous number of ova.

Genus NANNOENTERUM Ozaki, 1924

NANNOENTERUM BACULUM (Linton)

PLATE 18, FIGURES 250, 251; PLATE 19, FIGURES 252, 253

Gasterostomum sp. LINTON, Bull. U. S. Fish Comm. for 1899, p. 447, figs. 369-372, 1901.

Gasterostomum baculum LINTON, Bull. U. S. Bur. Fish., vol. 24, p. 362, figs. 233, 234, 1905.

Bucephalus baculum (Linton). NICOLL, Journ. Marine Biol. Assoc. United Kingdom, vol. 10, p. 401, 1914.

Nannoenterum baculum (Linton), MANTER, Parasitology, vol. 23, p. 397, 1931.

The material available when the original description of this species was written, like much of the material hitherto referred by me to the genus *Gasterostomum*, was in poor condition, being more or less macerated. It was not until subsequent examination of material was made that the circle of tentacles surrounding the anterior sucker was noted.

Body nearly linear, covered with dense spines, which are minute, flat, and scalelike in front view, but appear to be slender and bristlelike in edge view, as along the margins of the body. Anterior sucker relatively large, bluntly wedge-shaped; in dorsoventral view anterior end truncate, posterior end rounded; opening of sucker anterior and ventral, surrounded by about 20 short tentacles. Relative positions of the genitalia subject to some variation, owing to greater or lesser accumulation of ova in the uterus. Usually the ventral sucker is about the middle of the length. The intestinal cecum extends posteriorly, its walls made up of large cells. Testes near together, one following the other, more or less oval-elliptical, longer than broad, near middle of postacetabular region. Cirrus pouch extending to about the middle of the second testis. Ovary in front of testes, on a level with the posterior half of the intestinal cecum, smaller than testes, subspherical. Ovary and testes on right side. Vitellaria lateral, about 16 follicles on each side, in some cases nearly symmetrical, in others extending farther anteriorly or posteriorly than the other. Usually they extend from the level of the first testis to about the middle of the preacetabular region. In some of the mounted specimens there appear to be about 12 follicles on one side and 16 on the other; in others about 15 follicles on each side; as many as 18 on a side were noted. The folds of the uterus may extend from the

posterior end to within a short distance of the anterior end. The dark brown ova are usually massed in the midregions of the body obscuring the other genitalia. The ova have thickish, noncollapsed shells, bluntly rounded at one end, pointed at the other.

Measurements, formalin specimens in glycerin: Length, 2.8 mm., breadth, 0.35 mm.; diameter circle of tentacles, 0.17 mm.; diameter of neck behind tentacles, 0.14 mm.; anterior sucker, length, 0.11 mm., breadth, 0.1 mm.; ventral sucker, length, 0.072 mm., breadth, 0.075 mm.; ova, 0.024 by 0.013 mm., 0.024 by 0.018 mm.

In a specimen 2.22 mm. long the ventral sucker was 1.22 mm. from the anterior end.

The above description is based on material from the northern barracuda (*Sphyraena borealis*).

Hosts.—Northern barracuda (*Sphyraena borealis*), American smelt (*Osmerus mordax*), Spanish mackerel (*Scomberomorus maculatus*), mackerel scad (*Decapterus macarellus*), kingfish (*Menticirrhus saxatilis*), clear ray (*Raja diaphanes*), barndoor skate (*R. laevis*).

Record of collections.—All collections made by Vinal N. Edwards in the months of April, September, October, and November, on 13 dates, in 5 different years, from 1908 to 1913. (U.S.N.M. No. 8180.)

From barracuda: One hundred, more or less, collected April 24, 1908. Many, collected September 27, 1910; 10 fishes examined. Eight, collected September 11, 1911, from one fish. Four hundred and sixty, more or less, collected October 10, 1911. Twenty-five, collected October 11, 1911. Two thousand two hundred and fifty, estimated, collected October 23, 1911; 40 fishes examined. Twenty-one, collected October 22, 1912; 100 fishes examined. Many, collected October 29, 1912; 150 fishes examined. Many, collected November 18, 1912; 18 fishes examined. One, collected September 18, 1913; 4 fishes examined.

Two hundred and twenty-three, collected October 25, 1913; length, 4.27 mm., more or less, in formalin; 120 fishes examined. One hundred and sixteen, more or less, collected October 29, 1913; 100 fishes examined.

From smelt: Five, collected by Vinal N. Edwards, October 23, 1911, 8 fishes examined. These specimens, in formalin, were in poor condition, being more or less macerated. Length in formalin, 2.24 mm., breadth, 0.22 mm. In a balsam specimen the diameter of the ventral sucker is 0.06 mm.; anterior sucker, length, 0.12 mm., breadth, 0.09 mm. Ova, pointed at one end, 0.022 by 0.014 mm., in formalin.

From Spanish mackerel: One, collected August 10, 1904, specimen imperfect. A reexamination of *Gasterostoma* collected from the Spanish mackerel at Beaufort, N. C., and at Woods Hole, Mass.,

showed that while anterior tentacles were indistinct, their presence was indicated; also some specimens show folds of the uterus extending in front of the ventral sucker.

From mackerel scad: One (U.S.N.M. No. 8181), collected October 25, 1913; 20 fishes examined. Length, in formalin, 3.25 mm.; diameter of circle of tentacles, 0.28 mm., of body, 0.33 mm. Ova very numerous, from posterior end to a point 0.47 mm. back of the anterior end. Body minutely spinous. The cirrus pouch extends forward to level of anterior end of second testis; testes separated from each other by an interval less than the diameter of a single testis, and the ovary is separated from the first testis by an interval a little less than the diameter of the ovary. The vitelline follicles are partly concealed by ova. About 14 follicles can be counted on one side, extending from about the level of the anterior end of the second testis to a point 0.08 mm. from the anterior end. Dimensions in balsam: Length, 2.87 mm.; breadth, anterior, 0.17 mm., middle, 0.29 mm., near posterior end 0.18 mm.; anterior sucker, length, 0.14 mm., breadth, 0.14 mm.; diameter ventral sucker, 0.06 mm.; distance anterior end to vitellaria, 0.81 mm., to uterus, 0.49 mm.; ova pointed at one end, 0.024 by 0.012 mm.

From kingfish: Five (U.S.N.M. No. 8182), collected October 26, 1912. Length in formalin, 3.22 mm.; breadth, 0.24 mm.; about eight of the circle of papillae visible in dorsal view. Measurements in balsam: Length, 1.61 mm., breadth, 0.25 mm.; anterior sucker, length, 0.1 mm., breadth, 0.09 mm.; diameter ventral sucker, 0.05 mm.; ova, 0.024 by 0.015 mm. One specimen showed about 14 vitelline follicles on each side.

The collection contains examples of this *Nannoenterum* from two species of ray. Since the occurrence of this parasite in a ray is exceptional it is probably to be regarded as a case of introduction along with fish in which it was a common parasite. This is probably also the explanation of the frequent macerated condition in which this parasite was found in certain hosts.

Four (U.S.N.M. No. 8183), collected September 27, 1910, from stomach of clear ray. Length in formalin, 2.76 mm.; breadth, 0.35 mm.; anterior end surrounded by small, spinelike papillae; body nearly cylindrical, bluntly rounded at posterior end, tapering to anterior end; anterior, 0.25 mm. of length necklike. Measurements in balsam: Length, 2 mm.; breadth, 0.32 mm.; anterior sucker, length, 0.12 mm., breadth, 0.13 mm.; length of tentacles, 0.015 to 0.021 mm.; diameter of testis, 0.18 mm., of ovary, 0.13 mm.; ova, 0.021 by 0.013 mm. Two of the four mounted specimens have very few spines. The uterus extends from near the posterior end to a point about halfway between the vitellaria and the anterior end. In each of the specimens the ova

were massed in front of the ventral sucker, thus hiding much of the vitellaria. The follicles of the vitellaria are rounded masses about 0.03 mm. in diameter, about 10 counted on the right side and 16 on the left. On the right side they extend in a single row for a distance of about 0.5 mm.; on the left side they extend from the anterior edge of the first testis forward in an irregular double row, partly concealed by ova, for a distance of about 0.06 mm. The ovary lay a little way in front of the first testis to the right of the median line. The testes were nearly circular in outline, one following the other and about 0.4 mm. from the posterior end.

Six (U.S.N.M. No. 8184), collected November 20, 1912, from barn-door skate.

Measurements in formalin: Length, 2.66 mm.; diameter of circle of papillae, 0.15 mm.; maximum diameter of body, 0.28 mm.; about 20 short, conical papillae in anterior circle; ova, pointed at one end, 0.023 by 0.013 mm. The specimens in balsam are not in good condition. It was found that unless especial precautions were taken these gasterostomes, which had been preserved in formalin, shriveled badly when transferred from absolute alcohol to the clearing fluid.

NANNOENTERUM GORGON (Linton)

PLATE 19, FIGURES 254-256

Gasterostomum gorgon LINTON, Bull. U. S. Bur. Fish., vol. 24, p. 364, figs. 240-242, 1905.

The shape of the body is somewhat variable, but in most of the specimens of the collection there is not much difference in the breadth for the greater part of the length; covered anteriorly with dense, low, flat, rounded spines. Anterior sucker relatively large, surrounded by about 20 tentacles, which, when extended are slender-pointed. Ventral sucker behind middle of length. In one specimen, 2.66 mm. long, the ventral sucker was 1.68 mm. from the anterior end; in another, 2.9 mm. long, the ventral sucker was 1.57 mm. from the anterior end. The intestinal cecum extends anteriorly from the ventral sucker. The cirrus pouch may extend forward so as to overlap the second testis. The testes lie on the right side, one following the other, usually with a short interval between them. The ovary usually lies on a level with the ventral sucker, and a short distance in front of the first testis. The vitellaria are laterally placed, about 32 follicles in all, the anteriors of which are at about the anterior fourth, or fifth, of the body length, and the posteriors but little if any back of the ventral sucker. In one specimen four follicles on one side lay back of the ventral sucker, the most posterior of them on a level with the posterior edge of the ovary. There were 17 follicles on that side,

and but 13 could be made out on the other. The folds of the uterus may extend from the posterior end to the anterior sucker. The ova have thickish shells, tend to be more or less bluntly pointed at one end, and measure 0.018 by 0.01 mm. to 0.021 by 0.012 mm.

TABLE 11.—Measurements of five specimens of *Nannoenterum gorgon* in balsam

| Measurement | 1 | 2 | 3 | 4 | 5 |
|------------------------------------|------------|------------|------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 3.13 | 3.08 | 2.82 | 2.38 | 3.08 |
| Breadth, anterior..... | .25 | .25 | .35 | .22 | .22 |
| Breadth, middle..... | .35 | .42 | .39 | .29 | .33 |
| Breadth, near posterior end..... | .17 | .31 | .20 | .14 | .22 |
| Anterior sucker, length..... | .24 | .24 | .28 | .21 | .21 |
| Anterior sucker, breadth..... | .19 | .21 | .22 | .18 | .22 |
| Anterior sucker to vitellaria..... | .63 | .74 | .91 | .56 | .87 |
| Anterior sucker to uterus..... | .01 | .53 | .56 | .35 | .40 |
| Diameter ventral sucker..... | .06 | .06 | .06 | .06 | .06 |

Host.—Great amberfish (*Seriola lalandi*).

Record of collections.—Nine, collected August 14, 1906, 6 from intestine of host, 1 from pyloric ceca, 2 from stomach; all macerated.

Ninety-eight (U.S.N.M. No. 8185), collected by Vinal N. Edwards, September 20, 1910; three fishes examined. Dimensions in formalin: Length, 3.29 mm.; breadth, anterior 0.21 mm., middle 0.35 mm., posterior 0.21 mm.; length of tentacle 0.15 mm.; ova 0.02 by 0.01 mm.

Suborder PROSOSTOMATA Odhner, 1905

Family ASPIDOGASTRIDAE Poche, 1907

Genus STICHOCOTYLE Cunningham, 1884

STICHOCOTYLE NEPHROPIS Cunningham

PLATE 19, FIGURES 257-259

See STILES and HASSALL, U. S. Hyg. Lab. Bull. 37, p. 364, 1908, for earlier literature.

Stichocotyle nephropis ODHNER, Kongl. Svenska Vetensk.-Akad. Handl., vol. 45, No. 3, pp. 1-16 (reprint), 5 figs., 1 pl., 1910.

A single specimen of this trematode (U.S.N.M. No. 8186) was collected by Vinal N. Edwards from a barndoor skate (*Raja laevis*), taken off Nantucket, June 4, 1906.

The exact location of the worm in its host was not noted. The immature, encysted stage of this trematode has been found in the Norway and the American lobsters; the sexually mature stage has been found in Europe in the liver and gall bladder of species of *Raja*.

The specimen was stained and mounted in balsam. So far as the anatomy can be made out it is in agreement with Odhner's descrip-

tion of *S. nephropis*. There are about 22 ventral suckers. The genital pore lies near the anterior border of the first ventral sucker, a little to the right of the median line. The ovary is ventral and lies just behind the fifth ventral sucker. The shell gland is at the posterior median border of the ovary. The two testes are dorsal, separated from each other by a distance less than the diameter of a single testis and both lying between the sixth and seventh suckers. The early folds of the uterus are filled with sperm and scattered ova. A few follicles of the vitellaria were noted, lying along the dorsal side, a little in front of the first testis; thence they extend to within 1.5 mm. of the posterior end, as a single mass of more or less pyriform follicles. Throughout the posterior half or more of their course they occupy from one-third to one-half the diameter of the body. The folds of the uterus are very voluminous, and fill most of the body, from a point about 2.3 mm. from the anterior end to a point about 4.3 mm. from the posterior end. The ova are very numerous, oval-elliptical in outline, and have thick shells, about 0.1 by 0.06 mm. in the two principal diameters. None of the ova were observed to have a lid at one end, as figured by Odhner. The intestine and excretory vessels extend to very near the posterior end, where the excretory vessels unite in a short muscular sinus.

Measurements in balsam: Length, 42 mm.; breadth, 1 mm. from the anterior end, 1.4 mm., maximum, about the middle, 1.75 mm.; 1 mm. from the posterior end 0.36 mm.; pharynx, nearly circular in outline, diameter, 0.28 mm.; ovary, length, 0.35 mm., breadth, 0.49 mm.; first testis, length, 0.63 mm., breadth, 0.84 mm.; second testis, length, 0.75 mm., breadth, 0.77 mm.; distance between testes, 0.35 mm.; ova, 0.1 by 0.06 mm., thickness of shell, 0.01 mm. The ovary is 0.21 mm. in front of the first testis, and about 14 mm. from the anterior end of the body.

On August 2, 1926, Dr. Rudolph Bennett brought to my laboratory several specimens of the immature stage of this trematode collected from the rectum of a lobster (*Homarus americanus*). These agree with W. S. Nickerson's description of *S. nephropis* from the American lobster.⁶ The suckers range in diameter from 13 to 17 mm. Rudiments on the testes, ovary, and vitellaria are present (U.S.N.M. No. 8187).

On May 23, 1930, Miss Carol Moore brought to my laboratory at the University of Pennsylvania 15 specimens of the immature stage of *S. nephropis*, which she had found encysted in the serous coat of the rectum of a lobster.

⁶ Zool. Jahrb., Abt. Anat. und Ont., vol. 8, pp. 447-480, pls. 29-31, 1895.

Family STERINGOPHORIDAE Odhner, 1911

Subfamily STERINGOPHORINAE Odhner, 1911

Genus STERINGOPHORUS Odhner, 1905

STERINGOPHORUS FURCIGER (Olsson)

PLATE 19, FIGURES 260–265; PLATE 20, FIGURES 266, 267

Leioderma furcigerum Olsson, STAFFORD, Zool. ANZ., vol. 27, p. 486, 1904.

Steringophorus furciger (Olsson), ODHNER, Die Trematoden des arktischen Gebietes, pp. 305–310, pl. 2, figs. 6, 7, 1905.

Steringophorus furciger (Olsson), NICOLL, Parasitology, vol. 6, pp. 190, 192, 1913.

Steringophorus furciger (Olsson), FUHRMANN, Kükenthal-Krumbach's Handbuch der Zoologie, vol. 2, p. 33, fig. 39, 1928.

Distomes collected by Vinal N. Edwards from the four-spotted flounder and the winter flounder are here recorded.

Note made after preliminary examination of formalin material: Outline oval, tapering to blunt extremities, varying from short oval with breadth nearly half the length, to linear oval with breadth but little more than one third the length; translucent, with cirrus pouch and vitellaria showing as white opaque spots; uterus with smoky-brown ova; aperture of ventral sucker in most cases transverse.

The following description is based on whole mounts in balsam and on series of sections:

Body long-ovate, smooth, tapering to each end; posterior end a little more pointed than anterior. Oral sucker circular, ventrally placed; no prepharynx; pharynx much smaller than oral sucker; esophagus as long as or longer than pharynx; intestinal rami begin about halfway between oral and ventral suckers and extend to a point not far from halfway between the ventral sucker and the posterior end; ventral sucker broader than long, much larger than oral sucker. Cirrus pouch large, between intestinal rami and ventral sucker, its thick walls abundantly supplied with prostatic cells. Ovary morula-like, mainly on right side of median line between the right testis and the ventral sucker; vitelline glands two, lateral to testes and extending forward to about the level of the posterior edge of the ventral sucker. The uterus proceeds from the shell gland, just behind the ovary, forward to the ventral sucker, then turns and passes back between the testes and fills the greater part of the posttesticular space; returning, the uterus, or metraterm, passes on the dorsal side of the ventral sucker, on the left side of the cirrus pouch to the genital pore. The excretory vessel is a single dorsal tube from the posterior end to a point between the testes, where it divides into a right and a left branch, which extends to the anterior end. Laurer's canal

originates near the median line a very little ways in front of the forking of the excretory vessel, near the anterior ends of the testes and the posterior border of the ovary. In serial sections it could be traced to the shell gland. There is no seminal receptacle, but the early folds of the uterus are filled with sperm mingled with ova. The sperm-containing portion of the uterus extends anteriorly to the posterior edge of the ventral sucker. Vitelline ducts lead to a small yolk reservoir ventral to the shell gland. The ova are numerous and measure about 0.04 by 0.02 mm.

TABLE 12.—Measurements of eight specimens of *Steringophorus furciger* in balsam

| Measurement | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|--------------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 2.73 | 2.62 | 2.56 | 2.45 | 2.23 | 2.10 | 2.03 | 2.00 |
| Anterior end to ventral sucker..... | .84 | .70 | .67 | .70 | .59 | .70 | .63 | .53 |
| Ventral sucker to posterior end..... | 1.47 | 1.54 | 1.54 | 1.40 | 1.26 | 1.05 | 1.05 | 1.12 |
| Maximum breadth..... | .91 | .84 | .84 | .84 | .77 | .91 | .84 | .77 |
| Oral sucker, length..... | .28 | .24 | .26 | .25 | .26 | .28 | .25 | .24 |
| Oral sucker, breadth..... | .28 | .30 | .29 | .30 | .30 | .30 | .28 | .28 |
| Pharynx, length..... | .11 | .16 | .16 | .13 | .14 | .14 | .14 | .14 |
| Pharynx, breadth..... | .10 | .15 | .14 | .14 | .14 | .14 | .14 | .14 |
| Ventral sucker, length..... | .35 | .35 | .35 | .35 | .38 | .35 | .35 | .35 |
| Ventral sucker, breadth..... | .36 | .52 | .46 | .49 | .43 | .52 | .49 | .42 |

Measurements of No. 1 were made on a series of frontal sections. It will be noted that No. 6 and No. 7 differ from the others in being relatively shorter from the ventral sucker to the posterior end.

Hosts.—Four-spotted flounder (*Paralichthys oblongus*) and common flatfish (*Pseudopleuronectes americanus*).

Record of collections.—Many, collected June 1, 1907, from four-spotted flounder.

Many (U.S.N.M. No. 8188), collected June 1, 1907, from flatfish; eight fishes examined.

Mr. Edwards' notes state that many distomes were found in both the four-spotted flounder and the flatfish. The vial of this date of material from the four-spotted flounder contains but one distome, while that with material from the flatfish contains 340 distomes of this species.

Genus LINTONIUM Stunkard and Nigrelli, 1930

LINTONIUM VIBEX (Linton)

PLATE 20, FIGURES 268-271

Distomum vibex LINTON, Bull. U. S. Fish Comm. for 1899, pp. 281, 291, 292, figs. 48-51, 1900; *ibid.* p. 464, 1901; Bull. U. S. Bur. Fish., vol. 24, p. 402, fig. 188, 1905 (an error appears in the description and figure; the anterior

ends of the excretory vessels were mistaken for diverticula of the intestine); Bull. U. S. Bur. Fish., vol. 31, pt. 2, p. 584, 1911.

Lintonium vibex (Linton), STUNKARD and NIGRELLI, Biol. Bull., vol. 58, pp. 336-343, 1 fig., 1930.

On account of the close resemblance of this distome to *Steringophorus cluthensis* Nicoll, later referred by Odhner to a new genus, I was inclined to refer *D. vibex* to that genus. Since Prof. Stunkard, however, has evidently gone over the ground with great care, I shall accept his conclusions.

As supplementary to Prof. Stunkard's contribution a few observations on this interesting distome, together with a record of collections made by Vinal N. Edwards and myself in the Woods Hole region since 1901, are given.

Body smooth, longer than broad, flattened in life, or more or less fusiform, plump in preserved material, greatest diameter at about middle of postacetabular region, tapering to anterior end, posterior end bluntly pointed; ventral sucker much larger than oral; no prepharynx; esophagus short or lacking; pharynx much smaller than oral sucker; intestinal rami simple, extending nearly to posterior end. The genital pore is on the median line, behind the pharynx; cirrus spinose; cirrus pouch oval-elliptical, enclosing the seminal vesicle and prostate, and lying in front of the ventral sucker. Testes oval, opposite, usually a little in front of the middle of the postacetabular region. The testes are, with few exceptions, longer than broad. Out of 20 specimens mounted in balsam there is only one in which the testes are broader than long, and in it there is some indication that the testes are distorted; an average of the testes of 20 specimens in balsam gave a length of 0.36 mm. and a breadth of 0.22 mm. The ovary is trilobed and usually lies about on the median line behind the ventral sucker, its posterior half between the anterior thirds of the testes. In some cases it is near the posterior border of the ventral sucker and in front of the testes. The shell gland, in whole mounts, appears to lie on the left side of the ovary and to extend anteriorly a little in front of the ovary, where it is joined by the yolk ducts. On account of the thickness of these distomes the relative positions of these organs are not easily seen. An examination of sections shows that the ovary is dorsally placed; in strongly contracted specimens it can be seen to be dorsal to the posterior border of the ventral sucker. The shell gland is ventral to the ovary, and the testes are also ventrally placed. Laurer's canal was traced in a somewhat sinuous course in a series of cross sections from the dorsal surface to the shell gland. It was also noted in a series of sagittal sections (pl. 20, fig. 270). The early folds of the uterus are filled with sperm in which ova are intermingled. The voluminous folds

of the uterus extend from the space between the testes to the posterior end, passing dorsal to the left border of the ventral sucker and beside the cirrus pouch to the genital pore. The vitelline glands lie between the intestinal rami and the lateral margins of the body and extend from the level of the testes, or a little ways in front of them, nearly to the posterior end. In some cases they are continuous; in others they are broken up into follicles. In most cases that were observed there were six follicles on the right side and seven on the left. The excretory vessels under some conditions are conspicuous, appearing as rather large lateral vessels, which begin at the level of the oral sucker, or in some cases at the level of the pharynx, and extend to the posterior end, where they unite in a short excretory vessel with thick, muscular walls. The ova have rather thick shells, and are about 0.04 by 0.02 mm. in size.

Longitudinal and diagonal muscle fibers are strongly developed in the neck. A conspicuous feature of sections of this distome is a layer of deeply-staining subcuticular cells.

Found very commonly, but in small numbers in each host, in the puffers of the Woods Hole region, usually in the pharyngeal cavity.

Hosts.—Oldwife (*Balistes vetula*), puffer (*Sphoeroides maculatus*).

Record of collections.—From oldwife: Five, collected by Vinal N. Edwards, September 8, 1903. Ground color in formalin greenish, reddish chocolate where intestines showed through the body wall; plump, neck folded ventrally. Measurements, made on a series of cross sections of a strongly contracted specimen: Length, 2.5 mm.; breadth, 1.35 mm.; vertical diameter, 1.12 mm.; oral sucker, length, 0.23 mm., breadth, 0.42 mm.; pharynx, length, 0.14 mm., breadth, 0.21 mm.; ventral sucker, length, 0.77 mm., breadth, 0.84 mm.; ova 0.045 by 0.024 mm., with thickish shells, not collapsed.

From puffer: Collection of June 26, 1903, consisted of four vials containing 69 distomes from puffer, many of them in clusters adhering to each other by the ventral suckers. One hundred fishes examined by Vinal N. Edwards.

Eleven, collected by Vinal N. Edwards, July 11, 1903, "from throat" of puffer. Twenty, collected July 9, 1904, from pharynx of one puffer; very active, necks very extensible, becoming linear; tendency to adhere to each other by the ventral suckers; prevailing color blood-red in larger specimens, pale yellow in smaller worms, when flattened and viewed with transmitted light. One, collected by Vinal N. Edwards, September 12, 1904, "from gills" of puffer. Two, collected by Dr. Irving I. Field, July 8, 1905, "from body cavity" of puffer.

Two, collected August 6, 1906, from near opening of pharyngeal sack of puffer. General ground color in life pale red or flesh-color;

intestines dark brown; ova in distal portions of uterus dark amber, those in middle folds lemon-yellow, those in newer folds, near the shell gland, nearly colorless. Excretory vessels voluminous, the two lateral branches extending from the level of the oral sucker to the posterior end where they unite in a short muscular excretory vessel, which opens at the terminal excretory pore. These branches may be in position to simulate intestinal diverticula, especially when constricted at the anterior end, and filled with granular material resembling the contents of the intestine, and were so wrongly interpreted in the Beaufort report. Necks very flexible, becoming at times slender and linear. The worms have a tendency to coil ventrally, with suckers adhering to the post ventral region.

Seventy-one distomes, two of them immature, collected on eight dates, August 7 to 23, 1906, from 16 puffers. Thirty-eight, collected from 6 puffers on three dates, August 1 to 10, 1907. Fifty, collected from 16 puffers on four dates, June 27 to 30, 1910. On June 28 and subsequent dates circular ciliate Protozoa, identified by Dr. C. W. Hahn as *Cyclochaeta domerguei* Moroff, were found moving about on the surface of these distomes.

Fifty-one, collected from 27 puffers on seven dates in July, one in August, and one in September, 1910, from July 5 to September 6. All from pharynx of host, usually near the point where it merges into the distensible sack. Nine of the fishes examined had no distomes of this species, the others had from one to three. They ranged from immature forms, 2 to 3 mm. in length, to adults 10 mm. in length and 3 mm. to 4 mm. in breadth when moderately extended.

One, collected by Vinal N. Edwards on June 9, 1914, from puffer; six fishes examined. Three (U.S.N.M. No. 8189), collected July 2, 1915, one fish examined.

From Mr. Edwards' notes of collections in 1915, I find that he examined 149 puffers on 13 dates in May, June, and September, when no distomes of this species were recorded.

Subfamily HAPLOCLADINAE Odhner, 1911

Genus TERGESTIA Stossich, 1899

TERGESTIA PECTINATA (Linton)

Distomum pectinatum LINTON, Bull. U. S. Bur. Fish., vol. 24, pp. 386, 389, figs. 200-203, 1905.

Theledera pectinata (LINTON), Carnegie Inst. Washington, Publ. 133, pp. 40, 41, 1910.

Six distomes (U.S.N.M. No. 8190), belonging to this species were collected from the intestine of a frigate mackerel (*Auxis rochei*), July 12, 1912, taken in a fish trap in Buzzards Bay, Woods Hole.

Measurements, life, flattened: Length, 3.71 mm.; breadth, anterior, 0.34 mm., maximum, 0.6 mm.; breadth of oral sucker, 0.28 mm.; pharynx, length, 0.24 mm., breadth, 0.14 mm.; diameter of ventral sucker, 0.32 mm.; ova 0.024 by 0.018 mm.

The intestine contained orange-colored material in granular masses at some part of their course, in most cases near the posterior end of the rami.

Ova in balsam mounts measure 0.024 by 0.018 mm. to 0.027 by 0.018 mm.

Family ZOOGONIDAE Odhner, 1911

Subfamily LECITHOSTAPHYLINAE Odhner, 1911

Genus LECITHOSTAPHYLUS Odhner, 1911

LECITHOSTAPHYLUS NITENS (Linton)

PLATE 21, FIGURES 272-274

Distomum nitens LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 534, 535, pl. 51, figs. 5, 6; pl. 52, fig. 1, 1898; Bull. U. S. Fish Comm. for 1899, p. 443, 1901.—PRATT, Amer. Nat., vol. 36, p. 958, 1902.

Distoma nitens Linton, Looss, Zool. Jahrb., vol. 12, p. 710, 1899.

No record of this distome has been made since the description of the species was published. An examination of a series of frontal sections (U.S.N.M. No. 8192) makes it desirable to make a few additions to the original description.

There is a short prepharynx, and the intestinal rami extend back of the testes but do not reach to the posterior end. The left ramus is about 0.9 mm. and the right 0.8 mm. from the posterior end. There appear to be at least 10 vitelline follicles on the left side and 8 on the right. Seminal receptacles small, at posterolateral border of ovary; shell gland at posteroventral border of ovary. The cirrus pouch is on the left side of the median line. Measurements, of nearly frontal sections: Length, 4.5 mm.; breadth, at level of cirrus pouch, 1.18 mm., at level of ovary, 1.08 mm.; anterior end to ventral sucker, 1.26 mm.; diameter of oral sucker, 0.38 mm.; pharynx, length, 0.28 mm., breadth, 0.22 mm.; diameter of ventral sucker, 0.57 mm.; cirrus pouch is on the left side of the median line. Measurements, of nearly to 0.036 by 0.018 mm.; distance of testes from posterior end, left 2.1 mm., right 1.68 mm.

Looss⁷ points out the resemblance of this species to *Enodia megalochondros* Looss; Pratt places it in the subfamily Plagiorchiinae.

⁷ Zool. Jahrb., Abt. Anat. und Ont., vol. 12, p. 709, pl. 26, fig. 30, 1899.

Subfamily ZOOGONINAE Odhner, 1902

Genus ZOOGONOIDES Odhner, 1902

ZOOGONOIDES LAEVIS, new species

PLATE 21, FIGURES 275-277

Small distomes found on different occasions in the intestine of the tautog were at first thought to belong to the species *Z. viviparus* (Olsson) from *Pleuronectes microcephalus*, and reported by Odhner and Nicoll from a number of hosts mainly belonging to the Pleuronectidae.

The principal points of difference between these distomes from the tautog and *Z. viviparus* are the comparative absence of spines, an unimportant feature, and the greater length of the intestinal rami. There is a difference, also, in the position of the genital pore from that assigned to it by some authors. In this, however, there is some disagreement. Thus, Olsson's figure of his *Distoma vivipara*⁸ places the genital pore near the right side of the neck. Odhner⁹ describes and figures *Zoogonoides viviparus* (Olsson) as having the genital pore near the left margin at the level of the forking of the intestine. Nicoll¹⁰ gives its position as near the left margin somewhat back of the forking of the intestine. Fuhrmann¹¹ describes and figures the genital pore on the left side. In his characterization of the Zoogonidae he states that the genital pore is not far from the left border of the body.

While the resemblance of these distomes to *Z. viviparus* is close, they differ consistently in the length of the intestines, which extend beyond the ventral sucker about to the level of the seminal receptacle. Also, they appear to be practically devoid of spines. I do not find any mention of spines in my notes made on fresh material, or on formalin material collected by Mr. Edwards. Careful search on 50 or more specimens mounted in balsam resulted in the finding of two in which a few exceedingly minute spines were faintly visible at the extreme anterior end dorsal to the oral sucker.

These distomes are small, fusiform, and smooth, or with but few minute spines; yellowish, tinged with red; ventral sucker much larger than oral, near the middle or a little in front of the middle, its aperture transverse. Average of 10 specimens in balsam: Transverse diameter of oral sucker 0.14 mm., of ventral sucker 0.24 mm. There is no prepharynx; pharynx small, broader than long; esophagus short; intestinal rami extend back of the ventral sucker, approx-

⁸ Lunds Univ. Års-skrift, vol. 4, pt. 2, No. 8, pp. 28, 29, pl. 4, fig. 73, 1867-68.

⁹ Centralbl. Bakt. und Parasit., vol. 31, pp. 62, 63, fig. 2, 1902.

¹⁰ Ann. Mag. Nat. Hist., ser. 7, vol. 19, pp. 83, 84, figs. 8, 9, 1907.

¹¹ Kükenthal and Krumbach's Handbuch der Zoologie, vol. 2, p. 103, fig. 122, 1928.

imately to the middle of the postacetabular region; genital aperture on right side of neck, near margin, about on a level with the forking of the intestine; cirrus pouch in front of ventral sucker, oval-elliptical with thick walls, containing prostatic cells; seminal vesicle in two divisions, inclosed in cirrus pouch; testes opposite, at level of ventral sucker. The position of the testes is somewhat variable. In some cases they extend in front of the ventral sucker; in others they lie at the level of the posterior border of the ventral sucker, even extending for a short distance back of it. The ovary lies behind the ventral sucker, on or near the median line, either to the right or to the left of it; shell gland at posterior border of ovary; seminal vesicle and vitelline gland behind the ovary, their relative positions somewhat variable. Thus, in one the ovary was at the posterior edge of the ventral sucker, the seminal receptacle on the median line, with the vitelline gland on the left side. In another the seminal receptacle lay behind the vitelline gland. The folds of the uterus occupy the greater part of the postacetabular region. The ova, which in the older portion of the uterus may contain ciliated miracidia, are about 0.07 by 0.03 mm. in size in balsam. The metraterm passes on the right side of the ventral sucker to the genital pore. There is a large excretory vessel at the posterior end, the excretory pore being surrounded by rosettelike musculature.

As a rule these distomes do not much exceed 1 mm. in length. Measurements, life, flattened under cover-glass: Length, 0.8 mm.; breadth, anterior, 0.15 mm., at level of ventral sucker, maximum, 0.42 mm., at posterior end 0.1 mm.; oral sucker, length, 0.14 mm., breadth, 0.11 mm.; pharynx, length, 0.03 mm., breadth, 0.05 mm.; ventral sucker, length, 0.21 mm., breadth, 0.23 mm.; ova 0.068 by 0.028 mm.; an ovum containing a ciliated embryo measured 0.072 by 0.028 mm.

Type specimens.—U.S.N.M. No. 8193 (holotype and paratypes).

Hosts.—Tautog (*Tautoga onitis*), round herring (*Etrumens sadina*).

Record of collections.—Twenty-six (U.S.N.M. No. 8193), collected July 27, 1904, from one tautog; small, fusiform, reddish yellow; ventral sucker showing a tinge of red. At first the worms were contracted and somewhat concave ventrally. When flattened the outline is almost rhomboidal. Two, lying free in sea water, measured 0.41 by 0.23 mm. and 0.38 by 0.26 mm., respectively. When flattened the length increased to 0.8 mm.

Eighteen, collected August 9, 1904, from one tautog. One of these, rather larger than the others, was noted in which ova had not yet appeared. The uterus, in many folds, filled the posterior end of the body.

One, collected August 11, 1908, from tautog; length, 0.91 mm., breadth, 0.42 mm.; diameter of oral sucker 0.14 mm., of pharynx 0.03 mm., of ventral sucker 0.22 mm.

Three, collected August 6, 1910, from tautog; small, brownish yellow, fusiform. Measurements, life: Length, 1.12 mm.; breadth, 0.54 mm.; diameter of oral sucker 0.15 mm., of pharynx 0.05 mm., of ventral sucker 0.3 mm.

One, collected August 10, 1910, from tautog; length, 0.87 mm.; breadth, 0.42 mm.; uterus voluminous, but without ova.

Three, collected April 21, 1913, from tautog. Measurements in formalin: Lengths, 1, 0.96, 0.94 mm.; breadths, 0.43, 0.42, 0.42 mm.; diameters of oral suckers, 0.16, 0.14, 0.15 mm., of ventral suckers, 0.26, 0.28, 0.26 mm.

Six (U.S.N.M. No. 8194), collected October 23, 1913, from tautog.

Dimensions of largest in formalin: Length, 1.8 mm., breadth, 0.51 mm.; diameter of oral sucker, 0.18 mm., of ventral sucker, 0.28 mm.

An immature distome which appears to belong to this species is here recorded: One, immature, collected July 17, 1908, from round herring. Measurements, life: Length, 0.48 mm.; breadth, 0.26 mm.; diameter of oral sucker, 0.06 mm., of pharynx, 0.04 mm., of ventral sucker, 0.08 mm. Fusiform, broadest at level of ventral sucker, the posterior edge of which is at about the middle of the length. Testes opposite and about on a level with the posterior half of the ventral sucker; ovary behind testes; intestines extend nearly to posterior end of body. The excretory vessels contained exceedingly small globular bodies.

Genus *STEGANODERMA* Stafford, 1904

STEGANODERMA FORMOSUM Stafford

PLATE 21, FIGURES 278-282

Steganoderma formosum STAFFORD, Zool. Anz., vol. 27, pp. 486, 487, 1904.—

MANTER, Illinois Biol. Mon., vol. 10, No. 2, pp. 88-90, figs. 58-60, 1926.

A single distome (U.S.N.M. No. 8195), found by Vinal N. Edwards in a four-spotted flounder (*Paralichthys oblongus*), June 1, 1914, agrees, so far as the anatomy is shown, with Manter's excellent description of this species.

The specimen, mounted in balsam, is oblong-elliptical, rounded at the ends, minutely and densely spinose, spines flat and scalelike; oral and ventral suckers about equal; pharynx small and rather indistinct; esophagus much longer than pharynx. The intestinal rami begin at a point about 0.28 mm. from the anterior end and 0.24 in front of the ventral sucker. They could be traced as far back as the level of the posterior edge of the ventral sucker, where they were

hidden by the vitellaria. The genital pore is on the left of the median line about on a level with the forking of the intestine. The cirrus pouch is relatively large and long, its base dorsal to the ventral sucker, whence it curves forward and to the left to the genital pore. The testes are rounded lateral, opposite, at about the middle of the postacetabular space. The specimen was slightly damaged and the left testis was not clearly defined. Ovary somewhat subtriangular in outline, at right lateral border of ventral sucker. The vitellaria consist of a cluster of compact follicles on each lateral margin, from about the anterior border of the ventral sucker to about the anterior edge of the testes. The uterus lies between the testes and fills the middle space between the vitellaria and behind the ovary, and occupies a considerable portion of the posttesticular space. The excretory pore is surrounded by deeply staining cells, but the excretory vessels are not distinguishable. The granular appearance of the parenchyma, especially conspicuous in the neck, is a characteristic of this species. The dimensions of these bodies in this specimen are rather smaller than those given by Manter, very few of them measuring as much as 0.015 mm. in diameter.

Measurements in balsam: Length, 1.75 mm.; breadth, at level of ventral sucker, 0.62 mm., maximum about 0.7 mm.; distance of ventral sucker from anterior end 0.62 mm.; diameter of oral sucker 0.14 mm., of pharynx 0.05 mm., of ventral sucker 0.14 mm.; length of esophagus 0.3 mm.; ova about 0.039 by 0.024 mm.

There is also in Mr. Edwards' collection an example of this species (U.S.N.M. No. 3196) from *Acanthocottus octodecimspinosus*; date of collecting not given. Measurements in balsam: Length, 2.35 mm.; maximum breadth, at middle of length, 1 mm.; diameter of oral sucker, 0.19 mm., of pharynx, 0.06 mm., of ventral sucker, 0.021 mm.; length of esophagus about 0.4 mm.; cirrus pouch, length, 0.45 mm., breadth, 0.18 mm.; ova 0.03 by 0.015 mm. to 0.034 by 0.018 mm.

The ventral sucker is weak and was at first overlooked. In ventral view the posterior end of the cirrus pouch with the enclosed seminal vesicle can be seen plainly through its walls. The uterus is voluminous, its folds lying between the testes and filling the greater part of the posttesticular region; ova numerous. The body in front of the vitellaria is filled with round, oval, and pyriform granular bodies from 0.01 to 0.03 mm. in diameter; also the excretory vessel, near the terminal excretory pore, is surrounded by pyriform cells.

This species has been recorded by both Stafford and Manter from the halibut (*Hippoglossus hippoglossus*).

Family ACANTHOCOLPIDAE Lühe, 1909

Genus DEROPRISTIS Odhner, 1902

DEROPRISTIS INFLATA (Molin)

PLATE 21, FIGURE 283

Deropristis inflata (Molin), MANTER, Illinois Biol. Mon., vol. 10, No. 2, p. 110, 1926.

Body densely covered with spines on anterior half, becoming sparsely scattered on the posterior half. In dorsal view the spines at the anterior end are in regular transverse rows, length, 0.009 mm.; breadth at base, 0.004 mm. On the median line at the level of the inflated portion of the neck there is a patch of larger spines, as much as 0.024 mm. in length and 0.007 mm. in breadth. The spines on the lateral margins of the inflated portion are stout, length 0.021 mm.; breadth, 0.009 mm. On the ventral side the margin of the inflated portion is armed with stout spines, elsewhere the spines are small. Oral and ventral suckers nearly equal; distance from anterior end to ventral sucker about one sixth of the entire length. The pharynx is a little longer than broad. There is a short prepharynx, and an esophagus about as long as the pharynx. The cirrus was retracted in all the specimens observed. It is armed with relatively long and slender spines. The spinous retracted cirrus is followed by the seminal vesicle, which has a longer anterior and shorter posterior division. The metraterm appeared to lie close to the dorsal side of that portion of the invaginated cirrus which lay in front of the spinous portion. Back of the point of coincidence of position with the cirrus, the metraterm is lined with spines which resemble those of the cirrus. The proportions and relative positions of these parts differ in various individuals. In a typical specimen, 4.69 mm. in length, the anterior ends of the spinous portions of cirrus and metraterm were 0.21 mm. back of the ventral sucker; the metraterm, on the right side of the cirrus, measured 0.56 mm. in length and 0.14 mm. in greatest breadth. The spinous portion of the cirrus was about 0.50 mm. in length and 0.21 mm. in breadth. The ovary in this specimen lay 0.7 mm. in front of the first testis, and the anterior end of the first testis was 0.87 mm. from the posterior end of the body. First testis, length, 0.33 mm.; breadth, 0.19 mm.; second testis, length, 0.42 mm., breadth 0.41 mm.; posterior end of second testis, 0.28 mm. from posterior end of body; one testis overlaps the other by 0.14 mm. The vitellaria are diffuse and extend from about the level of the middle of the seminal vesicle to within a short distance of the first testis. Folds of the uterus, containing many eggs, fill the body from the seminal vesicle to the first testis. There is a large seminal recep-

tacle dorsal and posterior to the ovary. Ova in balsam about 0.045 by 0.021 mm. to 0.048 by 0.024 mm.

TABLE 13.—Measurements of five mounted specimens of *Deropristis inflata*, Nos. 1–3 in balsam; Nos. 4, 5 in glycerin

| Measurement | 1 | 2 | 3 | 4 | 5 |
|------------------------------|------------|------------|------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 2.10 | 2.80 | 4.27 | 4.97 | 4.09 |
| Breadth of neck..... | .24 | .39 | .36 | .43 | .43 |
| Breadth of body..... | .21 | .52 | .39 | .47 | .49 |
| Oral sucker, length..... | .04 | .09 | .10 | .13 | .13 |
| Oral sucker, breadth..... | .09 | .12 | .13 | .14 | .14 |
| Pharynx, length..... | .05 | .08 | .07 | .11 | .11 |
| Pharynx, breadth..... | .05 | .08 | .10 | .08 | .08 |
| Ventral sucker, length..... | .07 | .14 | .11 | .17 | .15 |
| Ventral sucker, breadth..... | .08 | .17 | .11 | .15 | .15 |

Host.—American eel (*Anguilla rostrata*).

Record of collections.—Two, collected August 14, 1905, slender, yellowish, with expanded neck; ova 0.047 by 0.023 mm. Thirty-three, collected December 6, 1909, small, slender, neck inflated, spinose.

Sixteen (U.S.N.M. No. 8197), collected November 18, 1911; length in formalin 4 mm. One, collected July 31, 1912, macerated, spines shed.

One, collected August 19, 1912, orange color by reflected light, rusty yellow by transmitted light; neck inflated, armed with strong spines; 6 low nodules on head. Dimensions, life: Length, 2.86 mm.; breadth, anterior 0.15 mm., neck 0.32 mm., body, maximum, 0.57 mm.; breadth of oral sucker 0.13 mm., of pharynx 0.07 mm., of ventral sucker 0.16 mm.; ova somewhat irregular, about 0.043 by 0.024 mm.

Nine, collected March 29, 1913. Forty, collected April 8, 1913. Two, collected April 21, 1913. Three, collected April 30, 1914; length 3.5 mm. in formalin. Six, collected May 1, 1914. Fifty-five, collected June 13, 1914, 1.42 to 5 mm. in formalin. A few, collected July 10, 1914.

DEROPRISTIS HISPIDA (Abilgaard)

PLATE 21, FIGURE 284; PLATE 22, FIGURES 285–287

Deropristis hispida (Rudolphi) LÜHE, in Brauer's Die Süßwasserfauna Deutschlands, vol. 17, Trematodes, p. 85, fig. 69, 1909.

The collection contains two of these distomes, collected May 13, 1913, by Vinal N. Edwards from the intestine of a small sturgeon (*Acipenser sturio*) taken at Menemsha Bight.

The expanded neck of this species is made up largely of strong muscle fibers and evidently acts as an organ of adhesion. There is a cluster of stout spines on each lateral margin of the neck and another on the dorsal surface about on a level with the pharynx.

In older worms the anterior surface of the body is covered with spines, but in younger specimens the surface is nearly devoid of spines. The ventral sucker is a little larger than the oral, and the pharynx is longer than the oral sucker.

Measurements in formalin: Length, 7.8 mm.; breadth of expanded portion of the neck, exclusive of spines, 0.57 mm., in front of ventral sucker, 0.21 mm., at middle of length, 0.29 mm., near posterior end, 0.35 mm.; oral sucker, length, 0.11 mm., breadth, 0.15 mm.; diameter of ventral sucker, 0.19 mm.; distance from anterior end of ventral sucker about 0.9 mm.

In another specimen: Oral sucker, length, 0.11 mm., breadth, 0.15 mm.; pharynx, length, 0.15 mm., breadth, 0.12 mm.; ventral sucker, length, 0.16 mm., breadth, 0.18 mm.; ova about 0.042 by 0.024 mm. in balsam.

In the older specimens the ova fill the space between the testes, which are at the posterior end of the body, and the seminal vesicle. The cirrus is long and spinous, the cirrus pouch extending far back of the ventral sucker, with the seminal vesicle at its posterior end. The metraterm lies beside the cirrus pouch and is lined with spines.

On July 20, 1924, two of these distomes, 4 and 6 mm. in length, were collected from a small sturgeon measuring 85 cm. in length (U.S.N.M. No. 8198).

Genus STEPHANOSTOMUM Looss, 1899

STEPHANOSTOMUM DENTATUM (Linton)

PLATE 3, FIGURE 25

Distomum dentatum LINTON, Bull. U. S. Fish Comm. for 1899, pp. 283, 294, figs. 64-67, 1900; *ibid.*, p. 483, 1901; Bull. U. S. Bur. Fish., vol. 31, pt. 2, p. 582, 1913.

This species is smaller and relatively broader than *S. tenuis*; also the ova are smaller, and the pharynx is relatively smaller.

In strongly contracted specimens the pharynx is contiguous with the oral sucker, but in individuals with the neck not greatly contracted a prepharynx can be seen. There does not appear to be an esophagus. The number of oral spines is 54; length of oral spines about 0.05 mm. The entire body may be covered with closely placed spines, most abundant on the neck, less numerous toward the posterior end. Specimens were seen which had lost some of or all the oral spines and most of the spines from the body. The body spines, seen in front view, are somewhat scalelike with bluntly rounded ends; in edge view, as seen on the margins of the neck, they are slender, tapering, and slightly recurved. The oral spines are of nearly uniform diameter for the basal half of the length, then taper gradu-

ally to the tip, which is sharp pointed. In most cases the oral sucker is ventrally placed; when the neck is extended it tends to become terminal.

The genital pore is on the median line at the anterior margin of the ventral sucker. The cirrus pouch passes on, or above, the right margin of the ventral sucker, and encloses the seminal vesicle; when not disturbed by compression it lies dorsal to the ventral sucker. It may be concealed, or more or less displaced by ova massed behind the ventral sucker. The testes lie on the median line, one following the other closely. There is considerable variation in their shape, some being nearly circular in outline, some longer than broad, some broader than long and some subtriangular. The anterior border of the first testis is usually not far from the middle of the length, and the distance of the second testis from the posterior end is greater than the length of a testis. The ovary is near the right anterior border of the first testis, usually nearly circular in outline, but in some cases broader than long. A seminal receptacle was not seen, the appearance being that of sperm in the early folds of the uterus. The uterus lies between the ovary and the ventral sucker, the metratrum passing along the left border of the ventral sucker to the genital pore. The vitellaria are diffuse, filling the posttesticular space and extending to about the level of the middle of the ventral sucker. They fill the marginal regions, and in many instances follicles lie both dorsal and ventral to the testes and ovary.

Host.—Summer flounder (*Paralichthys dentatus*).

Record of collections.—Three, collected July 27, 1904, not in good condition, macerated. One, collected August 9, 1904. Three, collected August 15, 1906. One, collected August 16, 1906. Ten, collected August 20, 1906; small, partly macerated, no spines around mouth, indistinct on body. One, collected August 16, 1929, macerated, spines evanescent; length, 1.85 mm.; breadth 0.6 mm.; ova 0.06 by 0.042 mm.

TABLE 14.—Measurements of four specimens of *Stephanostomum dentatum* in balsam

| Measurement | 1 | 2 | 3 | 4 |
|------------------------------|-------------|-------------|------------|-------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 1.40 | 2.10 | 2.80 | 2.91 |
| Maximum breadth..... | .77 | .70 | 1.00 | .77 |
| Oral sucker, length..... | .17 | .15 | .25 | .14 |
| Oral sucker, breadth..... | .18 | .14 | .18 | .19 |
| Pharynx, length..... | | .10 | .12 | .16 |
| Pharynx, breadth..... | | .10 | .11 | .11 |
| Ventral sucker, length..... | .18 | .17 | .25 | .22 |
| Ventral sucker, breadth..... | .24 | .18 | .21 | .23 |
| Ova..... | .057 by .03 | .045 by .03 | .06 by .04 | .057 by .03 |

Collected by Vinal N. Edwards on four dates in September, two in October, and one in November; eight fishes were examined and 62 distomes obtained. The greatest number on any one date was 47 from two fishes, collected on October 6. For the other dates the numbers recorded are 7, 2, 1, 3, 1, 1; one fish having been examined on each date (U.S.N.M. Nos. 8199-8200).

STEPHANOSTOMUM FILIFORME, new species

PLATE 3, FIGURES 26-28

Variable in length, slender, and nearly linear; oral spines about 44 to 48, number not exactly determined; coarse spines on neck, few and scattered toward posterior end; length of oral spines about 0.06 mm., of neck spines 0.03 mm.; neck variable, but relatively short; prepharynx long; esophagus short or lacking; intestines reach to posterior end; ventral sucker larger than oral; genital pore in front of ventral suckers; cirrus pouch and seminal vesicle long, equal in some cases to one third the length of the postacetabular region; testes near the posterior end, one following the other with but little interval between; ovary separated from the first testis by a greater or less interval; early folds of the uterus in front of ovary contain sperm; vitellaria diffuse, filling the posterior two thirds or more of the postacetabular space, but not reaching as far forward as the ventral sucker; uterus with many but not numerous ova in front of ovary.

Measurements of one of longer specimens in formalin: Length, 15 mm., breadth, of oral circle of spines, 0.28 mm., behind circle of spines, 0.21 mm.; maximum breadth, 0.44 mm.; distance of ventral sucker from anterior end, 2.1 mm.

Measurements of one of shorter specimens in balsam: Length, 8.22 mm.; breadth, oral circle of spines, 0.22 mm., behind circle of spines, 0.14 mm., at level of ventral sucker, 0.38 mm., at level of testes, 0.49 mm.; distance of ventral sucker from anterior end, 1.12 mm., from ventral sucker to vitellaria, 2.12 mm., from second testis to posterior end, 0.35 mm.; ovary, length, 0.19 mm., breadth, 0.18 mm.; first testis, length, 0.7 mm., breadth, 0.25 mm.; second testis, length, 0.74 mm., breadth, 0.28 mm.

Type specimens.—U.S.N.M. No. 8202 (holotype and paratypes).

Hosts.—Great amberfish (*Seriola lalandi*), crevallé (*Caranx hippos*), cocinero (*Paratractus caballus*).

Record of collections.—Five, collected August 14, 1906, from amberfish; 10 to 12 mm. long, much macerated. Twenty-eight (U.S.N.M. No. 8202), collected September 20, 1910, from amberfish; three fishes examined.

One (U.S.N.M. No. 8203), collected September 22, 1913, from crevallé; length 8 mm., breadth 0.6 mm., in formalin. Measurements in balsam: Length, 7 mm.; breadth, 0.46 mm.; diameter oral circle of spines, 0.22 mm.; oral sucker, length 0.11 mm., breadth 0.15 mm.; pharynx (indistinct), length 0.15 mm., breadth 0.12 mm.; ventral sucker, length 0.21 mm., breadth 0.24 mm.; ova, 0.051 by 0.036 mm.; length of oral spines about 0.07 mm., of neck spines 0.015 to 0.03 mm. This distome agrees rather closely with the distomes from *S. lalandi*. The number of oral spines could not be determined exactly, but there are at least 44 in the two circles. The neck is contracted, breadth behind circle of spines, 0.14 mm., then expanding to a breadth of 0.45 mm.; length of neck, that is, from anterior end to ventral sucker, 0.6 mm. Prepharynx longer than pharynx; cirrus pouch and seminal vesicle long, extending 1.5 mm. back of ventral sucker; distance of ovary from first testis 0.5 mm., from first to second testis 0.15 mm., from second testis to posterior end 0.5 mm.; uterus median, from ovary to genital pore; vitellaria dense, from posterior end to a point 1.4 mm. back of ventral sucker.

TABLE 15.—*Measurements of three specimens of Stephanostomum filiforme in balsam*

| Measurement | 1 | 2 | 3 |
|-------------------------------------|-------------|-------------|-------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 13.30 | 9.94 | 7.63 |
| Maximum breadth..... | .42 | .42 | .28 |
| Oral sucker, length..... | .14 | .14 | .14 |
| Oral sucker, breadth..... | .21 | .17 | .17 |
| Pharynx, length..... | .15 | .21 | .14 |
| Pharynx, breadth..... | .12 | .10 | .09 |
| Ventral sucker, length..... | .29 | .22 | .25 |
| Ventral sucker, breadth..... | .25 | .18 | .19 |
| Length of prepharynx..... | .84 | .56 | .77 |
| Anterior end to ventral sucker..... | 1.40 | .98 | 1.12 |
| Ovary to first testis..... | 1.12 | .35 | .45 |
| Ova..... | 0.06 by .04 | 0.06 by .04 | 0.06 by .04 |

One and a fragment (U.S.N.M. No. 8204), collected October 13, 1911, from the cocinero; 15 fishes examined: Length, 9 mm.; breadth, 1 mm., in formalin. Measurements in balsam: Length, 7.14 mm.; breadth, 0.35 mm.; oral sucker, length, 0.13 mm., breadth, 0.15 mm.; pharynx, length, 0.18 mm., breadth, 0.19 mm.; ventral sucker, length, 0.28 mm., breadth, 0.28 mm. (lateral view); length of oral spines about 0.06 mm., of neck spines about 0.03 mm.; ovary, length, 0.21 mm., breadth, 0.14 mm.; first testis, length, 0.63 mm., breadth, 0.25 mm.; second testis, length, 0.48 mm., breadth, 0.21 mm.; distance from ovary to first testis, 0.28 mm., from first to second testis, 0.14 mm., from second testis to posterior end, 0.35 mm.; ova, 0.06 by 0.04 mm.

Vitellaria dense, filling posterior part of body to within 1.9 mm. of ventral sucker. Distance from anterior end to ventral sucker 0.84 mm. Length of prepharynx about 0.32 mm.

STEPHANOSTOMUM TENUE (Linton)

PLATE 4, FIGURES 32-34

Distomum tenue LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 535, 536, pl. 52, figs. 2-8, 1898; Bull. U. S. Fish Comm. for 1899, pp. 455, 456, 468, 469, 1901.

Distomum tenue tenuissime LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 536, 537, pl. 52, figs. 9-12, 1898.

Distomes referred to this species from 10 species of fishes in the Beaufort, N. C., region, Bull. U. S. Bur. Fish., vol. 24, 1905.

Many of the distomes here recorded are imperfect in that the oral spines are either missing or in such condition that their exact number can not be determined; in many cases also the dermal spines are evanescent. About 42 oral spines were counted in distomes from *Roccus saxatilis* and *Morone americana* and about 48 in distomes from *Hemitripteris americanus*.

In general the ova of the distomes recorded under *S. tenue* measure 0.08 by 0.04 mm. or more, while those under *S. dentatum* are 0.06 by 0.03 mm. or less; all measurements were made on material mounted in balsam. The average diameters of oral sucker, pharynx, and ventral sucker of distomes from different hosts are as follows:

| Species | Oral sucker | Pharynx | Ventral sucker |
|--------------------------|-------------|---------|----------------|
| | Mm. | Mm. | Mm. |
| <i>S. tenue</i> | 0.18 | 0.225 | 0.32 |
| <i>S. dentatum</i> | .14 | .140 | .23 |

Hosts.—Sand lance (*Ammodytes americanus*), sea raven (*Hemitripteris americanus*), kingfish (*Menticirrhus saxatilis*), white perch (*Morone americana*), striped bass (*Roccus saxatilis*), toadfish (*Opsanus tau*).

Record of collections.—One (U.S.N.M. No. 8205), collected October 20, 1914, from sand lance. Measurements in balsam: Length, 3 mm.; breadth, 0.75 mm.; oral sucker, length, 0.17 mm., breadth, 0.22 mm.; pharynx, length, 0.32 mm., breadth, 0.28 mm.; ventral sucker, length, 0.35 mm., breadth, 0.35 mm.; ova, 0.096 by 0.054 mm. Most of the oral spines are missing, coarse spines on neck; prepharynx at least as long as pharynx; esophagus very short; seminal vesicle extends for three-fourths the distance from ventral sucker to ovary. There is a short interval between the testes in which a few vitelline follicles lie; ovary at anterior edge of testis; shell gland at anterior

median border of ovary; ova few; vitellaria from posterior end nearly to ventral sucker, not dense; intestines extend to posterior end of body.

Seventy-two (U.S.N.M. No. 8206), collected January 10, 1914, from sea raven; maximum length, in formalin, 5.5 mm. Body nearly linear; neck tapering, variable, average about 5.5 times in entire length; about 48 oral spines; length of oral spine about 0.05 mm.; spines on neck dense, length about 0.04 mm.; spines on body smaller, but continue to posterior end; prepharynx, when neck is not contracted, longer than pharynx; esophagus lacking; cirrus pouch dorsal to ventral sucker; seminal vesicle extends back of ventral sucker, but not halfway to ovary, more or less crumpled, as if crowded forward by ova; testes longer than broad, contiguous, or with short interval between; ovary nearly circular in outline, a little to right of median line, near anterior border of first testis. In some there is a short interval between ovary and testis in which follicles of the vitallaria lie. Vitellaria extend from posterior end to ventral sucker, follicles coarse. Testes near posterior end. In one distome, length, 4 mm., the second testis was 0.25 mm. from the posterior end; in another, length, 4.62 mm., the second testis was 0.35 mm. from the posterior end. Measurements in balsam: Length, 3.15 mm.; breadth, 0.7 mm.; oral sucker, length, 0.18 mm., breadth, 0.19 mm.; pharynx, length, 0.25 mm., breadth, 0.14 mm.; ventral sucker, length, 0.28 mm., breadth, 0.32 mm.; ova, average of eight, 0.08 by 0.04 mm.

One (U.S.N.M. No. 8207), collected September 8, 1910, from kingfish. Spines evanescent; oral spines missing; a few scattering spines on neck and dorsal side of body. Dimensions in balsam, lateral view: Length, 2.73 mm.; breadth, 0.56 mm.; oral sucker, length, 0.14 mm., breadth, 0.11 mm.; pharynx, length, 0.21 mm., breadth, 0.15 mm.; ventral sucker, length, 0.21 mm., breadth, 0.24 mm.; ova, 0.08 by 0.04 mm. Greatest breadth near posterior end at level of posterior testis, tapering to anterior end, posterior end bluntly rounded; prepharynx shorter than pharynx; esophagus very short or none; cirrus pouch long, slender, dorsal to ventral sucker; seminal vesicle long, pyriform, behind ventral sucker about halfway to ovary; testes about as broad as long, separated by a short interval which is filled with vitellaria; posterior testis 0.28 mm. from posterior end; ovary nearly circular in outline, at anterior border of first testis, on right side of median line; vitellaria extend to within about 0.1 mm. of ventral sucker; vitelline follicles rather coarse; ova in front of ovary, few.

Recorded from white perch: Proc. U. S. Nat. Mus., vol. 20, pp. 536, 537, 1898; Bull. U. S. Fish Comm. for 1899, p. 456, 1901. One (U.S.N.M. No. 8208), collected May 31, 1907, from white perch;

length, 7 mm. in formalin. Densely spinous on neck, spines continue to level of posterior testis. This specimen, mounted in balsam, shows only a lateral view of oral spines. There are about 42 spines in the two oral circles. Length of oral spines about 0.06 mm., of neck spines about 0.036 mm.; seminal vesicle extends more than halfway from ventral sucker to ovary; vitellaria extend from posterior end to level of anterior border of ventral sucker; a few follicles between testes; prepharynx as long as pharynx; esophagus short, or none; ova, 0.084 by 0.045 mm.

Recorded from striped bass: Proc. U. S. Nat. Mus., vol. 20, pp. 535, 536, 1898; Bull. U. S. Fish Comm. for 1899, p. 455, 1901. One (U.S.N.M. No. 8209), collected July 13, 1925, from striped bass. This distome was somewhat macerated, oral and cuticular spines missing. The seminal vesicle extends 1 mm. back of ventral sucker, to a point 0.7 mm. in front of ovary. The vitellaria extend to within 0.2 mm. of the ventral sucker, its follicles filling the intervals between the testes and between the ovary and first testis. The ovary is separated from the first testis by a space equal to its diameter, and the testes are separated from each other by a somewhat longer interval. Shell gland in front of ovary; no seminal receptacle could be distinguished, but the early folds of the uterus appeared to contain sperm. Dimensions in balsam: Length, 4.62 mm.; breadth, 0.56 mm. (maximum, at anterior border of ventral sucker); breadth behind ventral sucker, 0.45 mm.; oral sucker, length, 0.14 mm., breadth, 0.21 mm.; pharynx, length, 0.14 mm., breadth, 0.21 mm.; ventral sucker, length, 0.3 mm., breadth, 0.33 mm.; ova, 0.084 by 0.04 mm., 0.09 by 0.045 mm.; length of prepharynx, 0.35 mm.; esophagus lacking or very short. A reexamination of old material from this host was made and the number of oral spines found to be 42, as stated in the original description of the species.

Recorded from toadfish: Bull. U. S. Fish Comm. for 1899, pp. 468, 469, 1901.

STEPHANOSTOMUM VALDE-INFLATUM (Stossich)

Distomum valde-inflatum Stossich, LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 527, 528, pl. 47, figs. 1, 2, 1898; Bull. U. S. Fish Comm. for 1899, pp. 444, 464, 1901.

Since these immature, encysted distomes have not yet been allied with any adult stage it seems best to record them under this specific designation.

Hosts.—Filefish (*Ceratacanthus schoepfi*), silversides (*Menidia notata*), toadfish (*Opsanus tau*), sunfish (*Mola mola*).

Record of collections.—Recorded from filefish: Proc. U. S. Nat. Mus., vol. 20, pp. 527, 528, 1898; Bull. U. S. Fish Comm. for 1899;

pp. 444, 464, 1901. One, collected August 17, 1909, in cyst from filefish. Specimens collected July 13, 1911, in cysts on intestine of filefish; length, 1.12 mm., breadth, 0.8 mm. Large numbers of spherical cysts, collected August 21, 1915, from filefish, widely distributed in the muscles from tail to head, and between the vertebral spines, both haemal and dorsal; also in the peritoneal cavity, on the viscera and on the ventricle. In the flesh the spherical cysts, from 0.06 to 2 mm. in diameter, are enclosed in larger cysts 4.5 by 2.5 mm. Cysts on the ventricle and viscera are globular, without any of the white, granular, or cheesy material which is associated with the cysts in the flesh.

Many spherical cysts, collected September 6, 1927, from filefish in peritoneal cavity, on auricles and on mucous membrane of pharynx; a double circle of hooks around the mouth, about 32 in each circle.

Recorded from silversides: Bull. U. S. Fish Comm. for 1899, p. 444, 1901. Many globular cysts on viscera of silversides, collected by Dr. Irving A. Field on August 25, 1904. Few small cysts, collected August 30, 1910, from silversides; transparent, amber colored, and containing opaque distomes; cysts 0.8 mm. to 1 mm. in diameter; 24 fishes examined.

One, collected July 6, 1901, from toadfish; small, yellow, globular cyst, containing a distome with double circle of spines around mouth; about 24 spines in each circle. Few cysts on mesentery of toadfish, collected August 22, 1903. Four cysts on mesentery of toadfish collected August 25, 1903. Two cysts in stomach wall of toadfish, collected August 4, 1908.

A distome (U.S.N.M. No. 8210), collected from a sunfish, July 19, 1926, is here recorded. The specimen is not in good condition, having lost all the oral, and the greater part of the cuticular, spines. The neck is relatively longer and slenderer than in *S. dentatum*; also there is a seminal receptacle, which has not been observed in the distomes from the flounder. Measurements in balsam: Length, 1.82 mm.; breadth, 0.4 mm.; oral sucker, length, 0.12 mm., breadth, 0.14 mm.; pharynx, length, 0.12 mm., breadth, 0.06 mm.; ventral sucker, length, 0.18 mm., breadth, 0.25 mm.; ova, 0.054 by 0.027 mm., 0.06 by 0.036 mm.

Another small distome was noted that had spines around the mouth, but unfortunately it was lost before measurements had been made.

STEPHANOSTOMUM species

PLATE 4, FIGURES 29-31

Host.—Great amberfish (*Seriola lalandi*).

Three of the distomes (U.S.N.M. No. 8211), collected from this host, September 20, 1910, differ from the others obtained on this

date. They are much smaller and are sagittate, or long-oval, in outline instead of linear. They are somewhat macerated, all spines missing, except a few of the oral spines on one specimen. The greatest breadth is at about the middle of the postacetabular region, whence they taper rather uniformly to the anterior end, and are bluntly rounded posteriorly. The ventral sucker is much larger than the oral; pharynx longer than broad, and longer than the oral sucker; prepharynx as long as or longer than pharynx; esophagus short or lacking. The seminal vesicle extends far back of the ventral sucker; testes near the posterior end, one following and touching the other; ovary relatively small, at right anterior border of first testis; uterus between ovary and ventral sucker; vitellaria diffuse, follicles small, extending, in a specimen 2.28 mm. in length, to within 0.35 mm. of the ventral sucker. In optical section the neck shows a deeper layer of strong, transverse fibers, which are somewhat sinuous, and produce the effect of a lattice with lozenge-shaped openings, and an outer layer of fine, longitudinal fibers (pl. 4, fig. 31).

Measurements in balsam: Length, 3.22 mm., maximum breadth, 0.59 mm.; oral sucker, length, 0.14 mm., breadth, 0.15 mm.; pharynx, length, 0.28 mm., breadth, 0.14 mm.; ventral sucker, length, 0.27 mm., breadth, 0.28 mm.; oral spines, length, 0.021 mm., breadth, 0.012 mm.; ova, 0.06 by 0.03 mm.

These distomes bear some resemblance to *Lechradena edentula* Linton¹², which should be regarded as a species of *Stephanostomum*.

STEPHANOSTOMUM species

Host.—Leatherjack (*Oligoplites saurus*).

Two fragments of a distome (U.S.N.M. No. 8212), collected July 24, 1924, are here noted.

Measurements in balsam: Anterior fragment: Length, 2.8 mm.; breadth, 0.85 mm.; length of seminal vesicle, 1.26 mm., breadth, 0.18 mm.; ova, 0.069 by 0.036 mm. The anterior end of the seminal vesicle is about at the same level as the anterior follicles of the vitellaria, which are 0.49 mm. from the anterior end of the fragment on one side, and 0.63 mm. on the other. Posterior fragment: Length, 4.62 mm.; breadth, 0.7 mm.; first testis, length, 0.8 mm., breadth, 0.46 mm.; second testis, length, 0.87 mm., breadth, 0.46 mm.; ovary, length, 0.26 mm., breadth, 0.28 mm.; distance between ovary and first testis, 0.15 mm., between testes, 0.22 mm.; from second testis to posterior end, 1.3 mm. Vitellaria, composed of rather coarse follicles, fill the posttesticular space, the spaces between testes and those between ovary and testis. They are interrupted at

¹² Carnegie Inst. Washington Publ. 133, pp. 46, 47, fig. 87, 1910.

the levels of testes and ovary, begin again on front of the ovary, and continue in the anterior fragment along each lateral margin in a band about one third the breadth of the body. The anterior fragment is very densely spinose, the spines continuing to the level of the first testis, where they are sparse; length of spines about 0.01 mm.; testes long-oval, ovary nearly circular in outline; shell gland in front of ovary; no seminal receptacle seen; some indication that the supply of sperm had been exhausted, numerous nucleated cells, apparently unfertilized germ cells, lying in the uterus associated with the ova.

Family ECHINOSTOMIDAE Looss, 1902

Subfamily ECHINOSTOMINAE Looss, 1899

Genus ECHINOSTOMUM Rudolphi, 1809

ECHINOSTOMUM species

In June, 1915, twelve trout perch (*Percopsis omiscomaycus*) from Constantia, N. Y. (Oneida Lake), collected June 6, were sent to me for examination. Dr. Tarleton H. Bean in an accompanying letter stated that the collector reported that about 5 percent of the fish had "something wrong with the eyes." The fish had been taken from a small stream into which they had come to spawn. No distomes were found in any of the abnormal eyes. Tissues from diseased and from normal eyes were examined for bacteria by E. S. Linton. Numerous short bacilli were found in the abnormal eyes, none were found in the normal eyes. Two encysted distomes were found in an apparently normal eye, one in the connective tissue outside the eyeball, the other in one of the eye muscles; diameters of cysts 0.4 by 0.3 mm. and 0.3 by 0.22 mm.; distomes with a single circle of about 24 spines around the mouth, length of spines 0.04 mm.; neck spinose. In one of the fishes an eye which seemed to be more prominent than the other was opened and an encysted distome found in the teased material, apparently from the connective tissue surrounding the eyeball; body of distome minutely spinose; single circle of spines, 20 or more, around the mouth; length of spines, 0.035 mm. Length of distome, 0.34 mm. Another slightly bulging eye was examined and two encysted distomes found. The larger cyst measured 0.56 by 0.5 mm. What appears to be this specimen, compressed and mounted in balsam, is 0.8 mm. in length; diameter of crown of spines, 0.17 mm.; length of spines, 0.04 mm.; number of spines about 30; diameter of ventral sucker, 0.07 mm. The smaller cyst, 0.33 by 0.22 mm.; number of oral spines 20 or more; length of spines 0.035 mm. Another cyst adhering to the outside of an eyeball measured 0.37 by 0.34 mm.; distome with about 18 oral spines. (U.S.N.M. No. 8213.)

Subfamily HIMASTHLINAE Odhner, 1911

Genus HIMASTHLA Dietz, 1909

HIMASTHLA TENSA, new species

PLATE 4, FIGURE 35

Body nearly linear; neck short, covered with minute spines, about 0.02 mm. in length and continuing for a short distance back of the ventral sucker; pharynx small, close to oral sucker; esophagus long; intestines begin at anterior border of ventral sucker, indistinct in balsam mounts, but appear to extend to posterior end. Genital pore at anterior edge of ventral sucker on median line; cirrus pouch and seminal vesicle long, extending back of ventral sucker, the seminal vesicle more or less spirally curved; testes longer than broad, near posterior end, one following the other closely. In one of the specimens the testes are slightly irregular, the first having a deep notch on one side and the second being constricted about the middle of its length, the posterior half being distinctly narrower than the anterior. Ovary subglobular, a short distance in front of the first testis and a little to the right of the median line. An ample shell gland and vitelline reservoir lie between the ovary and first testis. The early folds of the uterus contain sperm. The vitellaria extend from the posterior end about to the posterior end of the seminal vesicle. The body is considerably elongated between the ovary and ventral sucker; numerous ova lie along the median line, between the marginal vitellaria, from the ovary to the anterior end of the vitellaria.

The ventral sucker is larger than the oral, and the mouth is surrounded by a single circle of spines, with two extra spines at the angles at each side. These extra spines are posterior to the others, and if continued would form an outer circle. The oral spines are about 0.02 mm. in length and 0.015 mm. in breadth; as near as could be determined the number of oral spines is about 32.

Measurements in balsam: Length, 5.32 mm.; maximum breadth, 0.59 mm.; breadth of circle of oral spines, 0.26 mm., of oral sucker, 0.11 mm.; pharynx, length, 0.11 mm., breadth, 0.07 mm.; ventral sucker, length, 0.31 mm., breadth, 0.31 mm.; ova somewhat variable, average of four 0.075 by 0.038 mm.; first testis, length, 0.5 mm., breadth, 0.32 mm.; second testis, length, 0.7 mm., breadth, 0.28 mm.; distance of second testis from posterior end, 0.7 mm.; length of esophagus, 0.35 mm.

Host.—Common codfish (*Gadus morrhua*).

Record of collections.—Three (U.S.N.M. No. 8214), collected January 22, 1915; 12 fishes examined.

Family ALLOCREADIIDAE Stossich, 1904

Subfamily ALLOCREADIINAE Looss, 1902

Genus LEBOURIA Nicoll, 1909

LEBOURIA TRUNCATA, new species

PLATE 3, FIGURES 21, 22

Small distomes, smooth, generally broadest near posterior end, tapering to anterior end; often subtriangular in outline; ventral sucker larger than oral; pharynx about half diameter of oral sucker; esophagus short, but in flattened specimens as long as or longer than pharynx; intestines reach to posterior end; genital pore near posterior end of pharynx, on median line, or near it. Cirrus and cirrus pouch not seen; seminal vesicle dorsal to ventral sucker, seen at the anterior border of the ventral sucker in one, where it appeared to have been crowded forward by the mass of ova; in another it lay at the right posterior border of the ventral sucker, length, 0.09 mm., breadth, 0.045 mm., and extending for about half its length back of the ventral sucker. It would appear that the cirrus is represented only by an ejaculatory duct. Testes two, diagonal, contiguous. Ovary in front of right testis, on right side of median line, lobed. Uterus between testes and ventral sucker, many ova lying along the left side and in front of the ventral sucker, as far as the pharynx, and in one case to the left side of the oral sucker. While not certainly made out, the early folds of the uterus appeared to contain sperm. Shell gland on left of ovary; vitellaria diffuse, from posterior end along the margins to the level of the pharynx. Ova in balsam about 0.06 by 0.03 mm.

Type specimens.—U.S.N.M. No. 8216 (holotype and paratypes).

Hosts.—Common weakfish (*Cynoscion regalis*), kingfish (*Menticirrhus saxatilis*), white perch (*Morone americana*), lizardfish (*Synodus foetens*).

Record of collections.—Collections of July 7, 1899, and August 6, 1900, from weakfish, on slides containing specimens of *Cymbephallus ritellosus*. Dimensions in balsam: Length, 1.57 mm., breadth, 0.75 mm.; breadth of oral sucker, 0.16 mm., of pharynx, 0.08 mm., of ventral sucker, 0.31 mm.; ova, 0.061 by 0.034 mm.

Twelve (U.S.N.M. No. 8215), collected September 10, 1928, from 8 young weakfish, from 68 to 112 mm. in length. These fish were seined on the same date and at the same locality as the examples of *Menticirrhus saxatilis* and *Synodus foetens*, from which this distome was also obtained.

One (U.S.N.M. No. 8216), collected September 11, 1907, from kingfish. Measurements, life: Length, 1.28 mm., breadth, 0.6 mm.; breadth of oral sucker, 0.12 mm., of pharynx, 0.07 mm., of ventral sucker, 0.28 mm.; ova, 0.061 by 0.034 mm. The specimen, in balsam, is much flattened, slightly broader at the level of the posterior edge of the ventral sucker than toward the posterior end; esophagus a little longer than pharynx.

One, collected September 23, 1913, from kingfish; 8 fishes examined. Length in balsam, 1.12 mm., breadth, 0.53 mm.

Twenty-four small distomes, collected September 10, 1928, from kingfish; 34 young fishes, 81 to 137 mm. in length, examined; same species found in young *Cynoscion regalis* and lizardfish (*Synodus foetens*), seined at the same locality on the same date. Dimensions of larger specimens in close agreement with those given above. Dimensions of the smaller distomes in balsam: Length, 0.67 mm.; breadth, 0.25 mm.; breadth of oral sucker, 0.08 mm., of pharynx, 0.045 mm., of ventral sucker, 0.13 mm.; ova 0.06 by 0.03 mm.

One (U.S.N.M. No. 8217), collected May 31, 1907, from white perch. Dimensions, balsam: Length, 0.70 mm., breadth, 0.38 mm.; diameter of oral sucker, 0.15 mm., of pharynx, 0.08 mm., of ventral sucker, 0.24 mm.; ova, 0.075 by 0.036 mm. Found adhering to a specimen of *Stephanostomum tenue*. Vitellaria dense, extending in front of ventral sucker; testes diagonal; ovary lobed, and adjacent to testis, to right of median line; only two ova in uterus.

One, collected September 11, 1928, from lizardfish; 15 fishes examined; same locality and date as specimens of species from *Cynoscion regalis* and *Menticirrhus saxatilis*.

LEBOURIA species

PLATE 3, FIGURE 23

A distome, near *Lebouria truncata*, is here recorded.

Body widest at ventral sucker, tapering rapidly to anterior, and more gradually to posterior end. Genital pore to left of median line, at level of posterior end of pharynx; prepharynx short, esophagus about as long as pharynx; seminal vesicle extends a little way beyond the posterior edge of the ventral sucker on the left side; intestines concealed by the vitellaria; testes diagonal, close together, at about middle of postacetabular space; ovary lobed, at right anterior border of first testis; uterus between ovary and ventral sucker; vitellaria diffuse, from posterior end along margins nearly to pharynx.

Measurements in balsam: Length, 1.12 mm.; breadth, 0.36 mm.; oral sucker, length, 0.10 mm., breadth, 0.08 mm.; pharynx, length, 0.07 mm., breadth, 0.06 mm.; ventral sucker, length, 0.18 mm., breadth, 0.25 mm.; ova, 0.075 by 0.033 mm.

Host.—Northern barracuda (*Sphyraena borealis*).

Record of collection.—One (U.S.N.M. No. 8218), collected October 29, 1926; 163 fishes examined.

LEBOURIA species

PLATE 3, FIGURE 24

Host.—Common flatfish (*Pseudopleuronectes americanus*).

Record of collection.—One specimen, collected May 16, 1916. Dimensions in balsam: Length 1.26 mm.; breadth 0.98 mm.; diameter of oral sucker 0.21 mm., of pharynx 0.09 mm., of ventral sucker 0.35 mm.; ova 0.072 by 0.034 mm. (U.S.N.M. No. 8219.) A small distome, near *L. truncata*, somewhat damaged and distorted, being broken on the left side near the posterior end, where a mass of eggs protrudes, and having the posterior end folded under ventrally. The testes appear to be nearly transverse, but the left testis has probably been crowded back by the mass of ova between it and the ventral sucker. Body smooth, ovate, broadest at level of testes, which are nearly transverse and near the posterior end; testes nearly circular in outline; ovary lobed, near anterior border of right testis; shell gland to left of ovary, median; vitellaria extend forward to level of oral sucker, follicles coarse, concealing intestines. So far as the anatomy can be made out there is a rather close agreement with the distomes from *Cynoscion regalis*.

Genus PODOCOTYLE Dujardin, 1845

PODOCOTYLE ATOMON (Rudolphi)

PLATE 1, FIGURES 1-7

Distomum simplex Rudolphi, LINTON, Bull. U. S. Fish Comm. for 1899, p. 485, 1901.

Siniatropus simplex (Rudolphi), STAFFORD, Zool. Anz., vol. 27, pp. 484, 485, 1904.—COOPER, Trans. Roy. Soc. Canada, ser. 3, vol. 9, sect. 4, pp. 185, 186, fig. 6-8, 1915.

Podocotyle atomon (Rudolphi), MANTER, Illinois Biol. Mon., vol. 10, No. 2, pp. 207, 208, fig. 49, 1926.

Body smooth, usually of nearly same breadth throughout; ventral sucker larger than oral; prepharynx short, esophagus as long as or longer than pharynx; intestines extend to posterior end; genital pore to left of median line, approximately near level of posterior end of pharynx; cirrus pouch anterior and dorsal to ventral sucker; seminal vesicle extending but a short distance back of ventral sucker; testes 2, relatively small, one following the other, in some cases with little or no interval between them, in others with an interval into which follicles of the vitellaria are inserted; ovary in front of first testis,

lobed, usually its posterior end three lobed; yolk reservoir dorsal to anterior border of ovary; seminal receptacle in front of and ventral to yolk reservoir, not clearly defined in mounted material, the sperm may be in the early folds of the uterus; shell gland ventral, in front of ovary; uterus between ovary and ventral sucker; ova, in balsam mounts, about 0.07 by 0.03 mm.; vitellaria diffuse, from posterior end along margins without interruption to the ventral sucker.

Hosts.—Long-spined sculpin (*Acanthocottus octodecimspinosus*), common eastern stickleback (*Gladiunculus bispinosus*), sea raven (*Hemitripterus americanus*), rusty dab (*Limanda ferruginea*), tomcod (*Microgadus tomcod*), grubby (*Acanthocottus acneus*), common gurnard (*Merulinus carolinus*), common flatfish (*Pseudopleuronectes americanus*), tautog (*Tautoga onitis*).

Record of collections.—All collections from *Acanthocottus octodecimspinosus* made by Vinal N. Edwards. Three, collected April 20, 1914, from sculpin; three, May 14, 1914; one, October 20, 1914; five, October 24, 1914, 80 fishes examined; two, October 30, 1914, 50 fishes examined.

Nine, collected April 5, 1915, from sculpin; 34, collected April 12, 1915; 22, collected April 26, 1915.

One, collected April 21, 1916, from sculpin, five fishes examined; 37 (U.S.N.M. No. 8220), collected April 24, 1916.

Many shapes and sizes among formalin material. The length varies from 2.2 mm., with a breadth of 0.52 mm., to 6 mm., breadth, 2.5 mm.; ova, 0.08 by 0.05 mm.

Measurements in balsam: Length, 5.88 mm.; breadth, 1.54 mm.; oral sucker, length, 0.32 mm., breadth, 0.36 mm.; pharynx, length, 0.21 mm., breadth, 0.21 mm.; ventral sucker, length, 0.46 mm., breadth, 0.57 mm.; length of esophagus, 0.49 mm.; breadth of first testis, 0.56 mm., of second testis, 0.6 mm.; ova 0.075 by 0.032 mm.

One (U.S.N.M. No. 8221), collected by Vinal N. Edwards, May 8, 1914, from eastern stickleback. Measurements in balsam: Length, 2.6 mm.; maximum breadth, 0.7 mm.; breadth of oral sucker, 0.2 mm., of pharynx, 0.14 mm., of ventral sucker, 0.32 mm., of first testis, 0.21 mm.; ova, 0.07 by 0.033 mm.

All collections from *Hemitripterus americanus* made by Vinal N. Edwards. Two, collected November 20, 1911.

Five of the 43 distomes collected on April 26, 1915, and May 26, 1915 (U.S.N.M. No. 8222), from sea raven belong to this species.

Following are average measurements of seven specimens in balsam, of which the smallest had a length of 2 mm., and breadth of 0.68 mm., and the largest a length of 4.54 mm. and breadth of 1.54 mm.; Length, 3.34 mm.; breadth, 1.03 mm.; breadth of oral sucker, 0.23 mm., of pharynx, 0.14 mm.; ventral sucker, 0.37 mm.; length of esophagus,

0.18 mm.; breadth of first testis, 0.33 mm., of second testis, 0.3 mm.; ova about 0.075 by 0.036 mm.

Recorded from rusty dab: Linton, Bull. U. S. Fish Comm. for 1899, p. 485, 1901. A reexamination of balsam mounts shows that these distomes belong here. Dimensions in balsam: Length, 2.71 mm., breadth, 0.84 mm.; oral sucker, length, 0.14 mm., breadth, 0.17 mm.; pharynx, length, 0.07 mm., breadth, 0.1 mm.; ventral sucker, length, 0.24 mm., breadth, 0.3 mm.; breadth of first testis, 0.29 mm., second testis, 0.28 mm.; ova, 0.084 by 0.048 mm. In the lateral view of another specimen the length of the pharynx is 0.07 mm., of the esophagus, 0.14 mm. (U.S.N.M. No. 8223).

One (U.S.N.M. No. 8224), collected March 31, 1913, from tomcod, in a lot of 75 or more distomes, all of which, except this, belong to the species *P. ollsoni*. Dimensions in balsam: Length, 3.20 mm., breadth, 1.18 mm.; length of esophagus, 0.17 mm.; first testis, length, 0.18 mm., breadth, 0.30 mm.

Two (U.S.N.M. No. 8225), collected February 17, 1913, from grubby.

Five, collected February 3, 1915, from grubby; 8 fishes examined. Two of these are immature, length, 1.85 and 1.96 mm.; lengths of others, mature, 2.94 to 3.29 mm. Length of one in balsam, 3.1 mm.; breadth, 0.96 mm.; length of esophagus, 0.24 mm.; first testis, length, 0.25 mm., breadth, 0.25 mm.

One (U.S.N.M. No. 8226), collected July 21, 1924, from common gurnard. Yellowish, and minutely rugose before compression; cirrus short, seminal vesicle enclosed in cirrus bulb; posterior end of seminal vesicle at anterior border of ventral sucker. Measurements in balsam: Length, 2.66 mm., breadth, 0.67 mm.; diameter of oral sucker, 0.22 mm.; pharynx, length, 0.1 mm.; breadth, 0.13 mm.; ventral sucker, length, 0.24 mm., breadth, 0.32 mm.; length of prepharynx, 0.04 mm., of esophagus, 0.13 mm.; ova, 0.075 by 0.036 mm.

Distomes referred to this species were collected by Vinal N. Edwards from the winter flounder on 19 dates in six different years in the months of February, April, May, October, and December. The infestation in all cases was light. Thus, the record shows that on 12 dates 131 fishes were examined and a total of 97 distomes found. The highest average per host on any date was less than five, when 19 distomes were obtained from four fishes. On four dates the record for each date was one distome, although on those dates 66 fishes were examined. The smallest adult with ova measures, in balsam, 1.22 mm., in length, the largest, 5.18 mm. An average of six gave the breadth, 0.95 mm., and breadth of first testis 0.31 mm. (U.S.N.M. Nos. 8227, 8228.)

Six (U.S.N.M. No. 8229), collected May 4, 1914, from the tautog. Largest, in formalin: Length, 5 mm.; breadth, 1.5 mm. In balsam, largest, length, 3.92 mm.; breadth, 1.12 mm.; smallest, length, 2.8 mm., breadth, 1 mm. Measurements in balsam: Length, 3.82 mm.; breadth, 1.06 mm.; breadth of oral sucker, 0.21 mm., of ventral sucker, 0.39 mm.; pharynx, length, 0.11 mm., breadth, 0.14 mm.; length of esophagus, 0.14 mm.; breadth of first testis, 0.14 mm.; ova, 0.075 by 0.039 mm. Average of six: Breadth, 0.95 mm; breadth of first testis, 0.32 mm. Vitellaria extend to ventral sucker, uninterrupted at level of testes.

PODOCOTYLE OLSSONI Odhner

PLATE 1, FIGURES 8-12

Distomum simplex Rudolphi, LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 525, 526, pl. 47, figs. 3-7, 1909; Bull. U. S. Fish Comm. for 1899, pp. 436, 468, 475, 485, figs. 331, 332, 1901.

Distomum vitellosum LINTON, Bull. U. S. Fish Comm. for 1899, p. 464, 1901.

Podocotyle olssoni ODHNER, Trematoden des arktischen Gebietes, Fauna Arctica, vol. 4, p. 327, 1905.—MANTER, Illinois Biol. Mon., vol. 10, No. 2, pp. 208, 209, fig. 50, 1926.

The principal points in which this species differs from *P. atomon* are its relatively shorter esophagus, the much longer cirrus pouch and seminal vesicle, and the greater breadth of the testes as compared with the breadth of the body. The vitellaria are usually interrupted at the level of the testes in *P. olssoni*, while they are, as a rule, continuous in *P. atomon*.

Thus, in *P. olssoni* the length of the esophagus seldom equals that of the pharynx, the seminal vesicle may extend back of the ventral sucker as much as halfway to the ovary, and the testes are relatively much larger than they are in *P. atomon*.

An average of 13 of each species showed for *P. atomon*: Breadth of body, 1 mm., of first testis, 0.31 mm.; for *P. olssoni*: Breadth of body, 0.6 mm., of first testis, 0.3 mm. That is, for these specimens the breadth of the tests was one-third the breadth of the body in *P. atomon*, and one-half in *P. olssoni*.

TABLE 16.—Comparison of average measurements in *Podocotyle atomon* and *P. olssoni*

| Species | Number of specimens | Oral sucker in ventral sucker | Pharynx in ventral sucker | Breadth of testis in breadth of body |
|-------------------------|---------------------|-------------------------------|---------------------------|--------------------------------------|
| <i>P. atomon</i> | 4 | 1.57 | 2.48 | 3.30 |
| <i>P. olssoni</i> | 6 | 1.85 | 3.08 | 1.54 |

P. olsoni has a tendency, especially if placed in fresh water or weak formalin, to become turgid, in which case the neck is reflected, often until it stands at right angles with the body. The ovary in both species is lobed, usually somewhat pestlelike with three lobes at the posterior end.

Distomes from a large number of Woods Hole fishes are here recorded. While showing much variation in shape and proportions, and in minor details of structure they agree in essential particulars with Odhner's description of the species.

Hosts.—Long-spined sculpin (*Acanthocottus octodecimspinosus*), American sole (*Achirus fasciatus*), sand lance (*Ammodytes americanus*), American eel (*Anguilla rostrata*), lumpfish (*Cyclopterus lumpus*), common codfish (*Gadus morrhua*), common eastern stickleback (*Gladiunculus bispinosus*), sea raven (*Hemitripterus americanus*), conger eel (*Conger conger*), tomcod (*Microgadus tomcod*), white perch (*Morone americana*), grubby (*Acanthocottus aeneus*), American smelt (*Osmerus mordax*), summer flounder (*Paralichthys dentatus*), yellow perch (*Perca flavescens*), codling (*Urophycis chuss*), pollack (*Pollachius virens*), common gurnard (*Merulinus carolinus*), puffer (*Sphoeroides maculatus*), goggler (*Trachurops crumenophthalma*), garfish (*Strongylura marina*).

Record of collections.—Collected by Vinal N. Edwards from the sculpin on 17 dates in 6 different years in the months of February, March, April, May, October, November, and December. (U.S.N.M. No. 8230.) The largest number recorded on any date was 19, when 8 fishes were examined; lengths, in formalin from 1.4 to 6 mm. The vitellaria in these distomes from the sculpin are, as a rule, interrupted at the level of the testes. Two were noted in which the vitellaria were continuous. On a slide containing 10 distomes, 5 were noted with vitelline follicles in front of the ventral sucker. Of some 30 other mounted specimens only 2 had the vitellaria as far forward as the anterior border of the ventral sucker. In a small proportion of the mounted specimens the testes are slightly lobed. Measurements in balsam: Length, 4.83 mm., breadth, 0.77 mm.; oral sucker, length, 0.18 mm., breadth, 0.23 mm.; pharynx, length, 0.11 mm., breadth, 0.11 mm.; ventral sucker, length, 0.34 mm., breadth, 0.38 mm.; first testis, length, 0.42 mm., breadth, 0.35 mm.; second testis, length, 0.42 mm., breadth, 0.42 mm.; ova, 0.072 by 0.042 mm.

From American sole: One, immature, collected October 14, 1915. Measurements in balsam: Length, 1.09 mm., breadth, 0.29 mm.; oral sucker, length, 0.08 mm., breadth, 0.11 mm.; pharynx, length, 0.045 mm., breadth, 0.03 mm.; diameter of ventral sucker, 0.18 mm.; breadth of first testis, 0.14 mm.

From sand lance: Two (U.S.N.M. No. 8231), collected October 14, 1914. Length, in formalin, 4 mm. Twelve fish examined.

Lengths in balsam, 3.08 and 1.96 mm. They agree with this species in all essentials.

From American eel: One, collected September 2, 1903; length, 2.32 mm., breadth, 0.38 mm. One, collected August 16, 1912. One, collected April 18, 1913; length in formalin, 4 mm.; measurements in balsam: Length, 3.15 mm., breadth, 0.56 mm.; oral sucker, length, 0.16 mm., breadth, 0.22 mm.; pharynx, length, 0.14 mm., breadth, 0.14 mm.; ventral sucker, lateral view, length, 0.37 mm., breadth, 0.33 mm.; first testis, length, 0.35 mm., breadth, 0.36 mm.

From lumpfish: One (U.S.N.M. No. 8232), collected May 9, 1916, from fish that had been preserved in formalin: Length, 5.5 mm., breadth, 1.5 mm. Measurements in balsam: Length, 3.71 mm., breadth, 0.77 mm.; oral sucker, length, 0.2 mm., breadth, 0.21 mm.; pharynx, length, 0.11 mm., breadth, 0.14 mm.; ventral sucker, length, 0.36 mm., breadth, 0.4 mm.; length of esophagus, 0.07 mm.; breadth of first testis, 0.38 mm.; ova, 0.084 by 0.042 mm. All the lumpfish examined in 1924 and 1926 had been taken in May. Some had been put at once in formalin, others were kept in aquaria. The dates given are those on which the fish were examined:

Two, June 23, 1924; length, life, 4.5 mm.

Four, June 24, 1926. Three fishes, which had been preserved in formalin examined; 2 distomes found in each of the two larger; lengths in formalin, 2.5 to 4 mm.

One, July 6, 1926. Measurements, life: Length, 2.94 mm.; breadth, 0.77 mm.; oral sucker, length, 0.14 mm., breadth, 0.16 mm.; pharynx, length, 0.13 mm., breadth, 0.1 mm.; ventral sucker, length, 0.28 mm., breadth, 0.38 mm.; ova, 0.085 by 0.044 mm.

Three, July 8, 1926; slender, white, flaccid; length of largest, 9 mm.; breadth, 0.67 mm. In balsam these distomes are slender and linear, the breadth of the body at the level of the testes being little more than the breadth of a testis. In the largest of the three the ova few and imperfect and confined to the metraterm. In the others the ova are many and of normal size.

One, July 10, 1926; slender and, before compression, irregular in outline: Length, 3.78 mm.; breadth, 0.63 mm.; breadth of oral sucker, 0.19 mm., of pharynx, 0.11 mm., of ventral sucker, 0.45 mm.; ova, 0.07 by 0.04 mm.

One, July 13, 1926, length, 3.45 mm.

An average of four of these distomes from the lumpfish gives the diameter of the ventral sucker twice that of the oral sucker, and a little less than three times that of the pharynx.

From common codfish: One, collected December 10, 1914; 25 fishes examined; length in formalin, 5.5 mm.

Twelve (U.S.N.M. No. 8233), collected January 16, 1915; 80 fishes examined; length in formalin, 2 to 7 mm.

These distomes from the cod are elongated, slender, with prominent ventral suckers. Average of four: Breadth, 0.49 mm.; breadth of first testis, 0.31 mm.

From common eastern stickleback: This distome was collected from the stickleback on 10 dates in 6 different years, in the months of April, May, June, and July. On all but one date the collections were made by Vinal N. Edwards. Distomes not numerous, 114 in all. Over 200 fishes were examined. The largest number recorded for any date is 25, when 40 fishes were examined. They range in length from 3 to 7 mm. in formalin. Many of them are turgid, with conical necks reflected dorsally at right angles to the body. In some cases the vitellaria are not interrupted at the level of the testes. Ventral sucker approximately twice the diameter of the oral sucker, and three times that of the pharynx. Measurements, life: Length, 3 mm., breadth, 0.42 mm.; breadth of oral sucker, 0.15 mm., of pharynx, 0.09 mm., of ventral sucker, 0.36 mm. (U.S.N.M. No. 8234.)

From the sea raven: Collected from this host by Vinal N. Edwards on 9 dates in 6 different years, in the months of January, April, May, October, and December. The record shows that 16 fishes were examined, from which 198 distomes were obtained. The greatest number recorded from one fish is 117, collected on May 15, 1916; the smallest for any one date is one on December 24, 1912, when three fishes were examined. A distome, one of a lot of 16 collected on April 26, 1915, is exceptional in that, in spite of its size (length, 9 mm., maximum diameter, 1.12 mm.) no ova are present. It would appear that something had gone wrong with its egg-making mechanism. In front of the ovary there is a great deal of granular material associated with the follicles of the vitellaria. Masses of this material lie in front of the vitellaria, extending on the left side to the middle of the ventral sucker, and on the right side to its anterior border. (U.S.N.M. No. 8235.)

While most of these distomes from the sea raven maintain a breadth that does not vary greatly, the point at which the greatest breadth occurs varies. Thus, the greatest breadth in some is at the level of the testes, in others behind the testes, and in yet others between the ovary and ventral sucker. There is great variation also in the ratio of length to breadth. This is due to the fact that living specimens, in which the breadth may be as great as half the length, if placed in fresh water, or weak formalin, may become elongated, slender, and cylindrical, often with neck reflected and ventral sucker projecting. The cirrus is smooth, and when exerted is seen to have a bulbous base. The vitellaria, in extended specimens, are interrupted at the level of the testes; in contracted specimens they may be con-

tinuous. Average of four in balsam: Testes in breadth, 2; oral sucker in ventral sucker, 1.63; pharynx in ventral sucker, 3.

On July 11, 1927, five distomes were collected from a sea raven measuring 20 cm. in length. These, mounted in balsam, are seen to taper rather uniformly from about the level of the ovary to the posterior end. In one the seminal receptacle is situated at the left anterior border of the ovary; in the other it is greatly enlarged, the ovary being compressed between it and the first testis. It measures 0.16 mm. in length and 0.23 mm. in breadth. In another the ovary is crowded to the right side of the body by a mass of yolk, the yolk reservoir being greatly distended. The greatly reduced seminal vesicle in this specimen lies along the left side of the yolk reservoir. The latter is pyriform, length, 0.28 mm., greatest breadth, 0.17 mm. The ovary, length, 0.18 mm., breadth, 0.14 mm., is crowded into a triangular space at the anterior left border of the first testis. In three of these specimens the esophagus about equals the pharynx in length, in the other it is a little longer than the pharynx.

Recorded from the conger eel: Linton, Bull. U. S. Fish Comm. for 1899, p. 436, 1901.

Recorded from the tomcod: Linton, Proc. U. S. Nat. Mus., vol. 20, p. 526, 1898; Bull. U. S. Fish Comm. for 1899, p. 475, figs. 331, 332, 1901. Collected from this host on 116 dates in 13 different years; 21 dates in January, 10 in February, 2 in March, 36 in April, 6 in May, 2 in June, 4 in July, 1 in August, 5 in September, 12 in October, 5 in November, and 12 in December (U.S.N.M. No. 8236). All collections with the exception of those in July and August made by Vinal N. Edwards. These distomes vary greatly in length and shape. Most of those preserved in formalin vary in length from less than 1 to 6 or 7 mm., but slender, elongate forms occur that measure as much as 12 mm. Most of them are linear with prominent ventral suckers and with vitellaria interrupted opposite the testes. It should be noted, however, that living forms which are thickish, with closely appressed testes and unbroken vitellaria, may change, under pressure of the cover glass, to slender, elongate forms with vitellaria interrupted at the level of the testes. Also, when placed in fresh water, they become turgid, lengthened, and cylindrical, the acetabulum prominent and the neck reflected dorsally. The same changes follow immersion in weak formalin. Only one case was noted in which the ovary was not distinctly lobed; usually the ovary is 3-lobed at the posterior end, with a single anterior lobe, like the handle of a pestle. The testes in a few cases were slightly lobed. But one case was noted in which the body wall formed a raised margin around the ventral sucker. The number of fishes examined was not recorded in every instance. Following is a summary of collections in which the number of fishes examined was recorded:

TABLE 17.—*Record of specimens of Podocotyle olsoni collected from tomcod*

| Month | Fishes examined | Distomes found | Average number per host |
|----------------|-----------------|----------------|-------------------------|
| January..... | 327 | 1,000 | 3.06 |
| February..... | 178 | 1,760 | 10.55 |
| March..... | 42 | 120 | 2.85 |
| April..... | 541 | 2,411 | 4.45 |
| May..... | 90 | 115 | 1.20 |
| June..... | 5 | 57 | 11.42 |
| July..... | 12 | 15 | 1.25 |
| August..... | 13 | 1 | .08 |
| September..... | 17 | 35 | 2.06 |
| October..... | 93 | 145 | 1.55 |
| November..... | 40 | 59 | 1.47 |
| December..... | 136 | 151 | 4.78 |

Measurements of one in balsam: Length, 4.66 mm., breadth, 0.7 mm.; oral sucker, length, 0.2 mm., breadth, 0.22 mm.; pharynx, length, 0.11 mm., breadth, 0.13 mm.; ventral sucker, length, 0.34 mm., breadth, 0.39 mm.; length of esophagus, 0.08 mm.; breadth of testis, 0.42 mm.; ova, 0.072 by 0.039 mm. Measurements in formalin: Length, 6.15 mm., breadth, 0.65 mm.; diameter of oral sucker, 0.25 mm., of pharynx, 0.1 mm., of ventral sucker, 0.4 mm.; ova, 0.084 by 0.056 mm.

From the white perch: As in distomes from other hosts there is here a considerable variation in size and in details of structure. The smallest, in balsam, is 1 mm. in length and 0.11 mm. in diameter; the largest, 4.9 mm. in length and 0.56 mm. in breadth. The esophagus is as long as the pharynx. In many cases the vitellaria are not interrupted at the level of the testes. In some the vitellaria are interrupted on one side and not on the other. Cirrus smooth with basal bulb. Breadth of testis one-half or more the breadth of the body.

One, collected August 8, 1906. Fifteen, collected July 20, 1910. Collected by Vinal N. Edwards on six dates in four years, in April, May, and October, one to six on each date; 16 in all; lengths 2 to 4 mm. in formalin. (U.S.N.M. No. 8237.)

From the grubby: Collected from this host by Vinal N. Edwards on three dates: Three, December 23, 1905; length, 5.5 mm. in formalin. Two, April 14, 1910; 10 fishes examined; length, 3.5 mm. in formalin. Thirteen (U.S.N.M. No. 8238), February 3, 1915; 8 fishes examined. The smallest specimens, about 2 mm. in length and 0.5 mm. in breadth, are immature. Others with ova from 2.8 to 4.13 mm. in length. Measurements in balsam: Length, 3.71 mm., breadth, 0.66 mm.; oral sucker, length, 0.18 mm., breadth, 0.22 mm.; pharynx, length, 0.13 mm., breadth, 0.14 mm.; ventral sucker, length, 0.18 mm., breadth, 0.22 mm.; breadth of first testis, 0.35 mm.; ova, 0.075 by 0.045 mm.

From the American smelt: Collected by Vinal N. Edwards on two dates: Five, January 25, 1910. Thirty-six (U.S.N.M. No. 8239), June 20, 1914. In formalin, length of body, 5.8 mm., of neck, 0.7 mm.; diameter of body, 0.6 mm. Elongated, in most cases arcuate; necks short, arcuate, some reflected dorsally. Measurements, balsam: Length, 4.41 mm., breadth, 0.42 mm.; oral sucker, 0.14 mm., breadth, 0.15 mm.; pharynx, length, 0.13 mm., breadth, 0.08 mm.; ventral sucker, length, 0.28 mm., breadth, 0.29 mm.; ova, 0.08 by 0.04 mm.

From the summer flounder: Collected by Vinal N. Edwards on two dates: Two (U.S.N.M. No. 8240), September 20, 1915. Measurements in balsam: Length, 4.06 mm., breadth, 0.35 mm.; oral sucker, length, 0.14 mm., breadth, 0.15 mm.; pharynx, length, 0.08 mm., breadth, 0.1 mm.; ventral sucker, length, 0.25 mm., breadth, 0.21 mm.; first testis, length, 0.28 mm., breadth, 0.2 mm.; ova, 0.075 by 0.045 mm. Lateral view: Seventeen, October 3, 1915, 3 mm. to 6 mm. in length; slender, turgid.

From the yellow perch: One (U.S.N.M. No. 8241), collected April 23, 1914; length in formalin, 7 mm. Measurements in balsam: Length, 6.16 mm., breadth, 0.59 mm.; oral sucker, length, 0.21 mm., breadth, 0.12 mm.; pharynx, length, 0.12 mm., breadth, 0.11 mm.; ventral sucker, length, 0.31 mm., breadth, 0.33 mm.; length of esophagus, 0.15 mm.; first testis, length, 0.49 mm., breadth, 0.5 mm.; ova, 0.078 by 0.042 mm. There is a distinct seminal receptacle dorsal to the ovary and extending forward dorsal to the yolk reservoir.

From the codling: One, collected November 17, 1913; 30 fishes examined; length, 4.5 mm. in formalin. One (U.S.N.M. No. 8242), collected May 28, 1914; 10 fishes examined; length, 2.5 mm. in formalin. One, small, collected by Dr. G. A. MacCallum, August 20, 1915. Measurements, balsam: Length, 1.85 mm., breadth, 0.56 mm.; oral sucker, length, 0.13 mm., breadth, 0.17 mm.; pharynx, length, 0.07 mm., breadth, 0.1 mm.; ventral sucker, length, 0.28 mm., breadth, 0.38 mm.; breadth of first testis, 0.31 mm.; ova, 0.072 by 0.036 mm.

From the pollack: Twenty-four, collected August 19, 1908. Four (U.S.N.M. No. 8243), collected April 20, 1914. One, collected April 8, 1915. One, collected August 30, 1920. Length in balsam, 1.72 mm. to 4 mm. Measurements of one in balsam: Length, 1.92 mm., breadth, 0.53 mm.; oral sucker, length, 0.14 mm., breadth, 0.13 mm.; pharynx, length, 0.08 mm., breadth, 0.08 mm.; ventral sucker, length, 0.25 mm., breadth, 0.3 mm.; length of esophagus, 0.11 mm.; ova, 0.072 by 0.036 mm. A prepharynx could be distinguished in a few specimens which had been flattened.

From the common gurnard: Two (U.S.N.M. No. 8244), collected April 16, 1915; lengths in formalin, 2 mm. and 3.5 mm. Measurements in balsam: Length, 2.32 mm., breadth, 0.77 mm.; oral sucker,

length, 0.17 mm., breadth, 0.22 mm.; pharynx, length, 0.1 mm., breadth, 0.11 mm.; ventral sucker, length, 0.31 mm., breadth, 0.42 mm.; length of esophagus, 0.07 mm.; ova, 0.08 by 0.04 mm.

From the puffer: Recorded by Linton (*Distomum vitellosum*), Bull. U. S. Fish Comm. for 1899, p. 464, 1901. One, partly macerated, collected August 2, 1907. One, small, collected August 10, 1907. Three, collected June 8, 1914; largest, in formalin, 4.5 mm. One, collected June 8, 1916. These specimens in balsam are somewhat shriveled, but are in sufficiently good condition to identify. The ovary is lobed and pestle-shaped, and the vitellaria are interrupted opposite the testes.

From the goggler: One (U.S.N.M. No. 8245), collected September 13, 1915; length, in formalin, 5 mm. Measurements in balsam: Length, 4.76 mm., breadth, 0.56 mm.; diameter of oral sucker, 0.2 mm., of pharynx, 0.11 mm., of ventral sucker, 0.35 mm., of first testis, 0.35 mm.; ova, 0.078 by 0.045 mm. Cirrus exerted, smooth, length, 0.23 mm.; diameter at tip, 0.04 mm., at base, 0.06 mm.; ovary trilobed; vitellaria interrupted at level of testes.

From the garfish (*Strongylura marina*): Two, collected October 9, 1915; length in formalin, 3.82 mm. One, collected July 12, 1926. Measurements in balsam: Length, 3.15 mm., breadth, 0.52 mm.; breadth of oral sucker, 0.17 mm., of pharynx, 0.13 mm., of ventral sucker, 0.27 mm.; ova, 0.08 by 0.045 mm.

PODOCOTYLE species

PLATE 22, FIGURE 288

Body slender, greatest breadth at about level of ventral sucker; diameter of ventral sucker about twice that of oral sucker; diameter of pharynx about half that of oral sucker; prepharynx short; esophagus as long as or longer than pharynx; intestines extend nearly to posterior end. Genital pore in front of ventral sucker, a little to right of median line; cirrus pouch extends back of ventral sucker, on the left side; seminal vesicle at base of cirrus pouch; testes relatively large, the first rounded and slightly lobed, the second somewhat rhomboidal; ovary in front of first testis, short pestle-shaped, the posterior end 3-lobed; seminal receptacle on right side of ovary; shell gland in front of ovary; uterus between shell gland and ventral sucker; no ova in uterus; one ovum noted in shell gland, about 0.024 by 0.015 mm., probably not to be regarded as a fully formed egg; vitellaria extend from about the level of the posterior edge of the ventral sucker to the posterior end, interrupted at level of testes, but follicles lying between the testes and between the first testis and ovary.

Measurements in balsam: Length, 1.56 mm.; breadth, anterior, 0.09 mm.; at level of ventral sucker, 0.4 mm., at level of ovary, 0.21 mm., at level of second testis, 0.17 mm., near posterior end, 0.11 mm.; oral sucker, length, 0.07 mm., breadth, 0.08 mm.; pharynx, length, 0.05 mm., breadth, 0.04 mm.; ventral sucker, length, 0.14 mm., breadth, 0.15 mm.; first testis, length, 0.15 mm., breadth, 0.12 mm.; second testis, length, 0.17 mm., breadth, 0.14 mm.; ventral sucker to ovary, 0.24 mm.; second testis to posterior end, 0.26 mm.

Host.—Chinook salmon (*Oncorhynchus tshawytscha*).

One (U.S.N.M. No. 8246), found on slide with specimens of *Genarches infirmus*, from young salmon, Sacramento Basin, Calif., May 1900.

Genus CYMBEPHALLUS Linton, 1934

The genus *Cymbephallus* differs from *Podocotyle* in having a muscular sucker at the opening of the ejaculatory duct and a raised border surrounding the ventral sucker, this border being more or less scalloped, papillate, or fimbriate.

CYMBEPHALLUS VITELLOSUS (Linton)

PLATE 2, FIGURES 18-20

Distomum vitellosum LINTON, Bull. U. S. Fish Comm. for 1899, p. 290, figs. 38, 39, 1900; *ibid.*, p. 416 (page references to hosts in Woods Hole, Mass., region), figs. 333-340, 1901; Bull. U. S. Bur. Fish., vol. 24, p. 335 (page references to hosts in Beaufort, N. C., region), figs. 176-178, 1905; Proc. U. S. Nat. Mus., vol. 33, p. 105, figs. 63, 64 (notes on parasites of Bermuda fishes), 1907.—SUMNER, OSBURN, and COLE, Bull. Bur. Fish., vol. 31, pt. 2, p. 584 (list of hosts in Woods Hole region), 1911.

Cymbephallus vitellosus (LINTON), Journ. Washington Acad. Sci., vol. 24, p. 81, 1934.

Body smooth, of various shapes, often in living specimens with breadth one-third the length; under pressure, or when placed in fresh water, they tend to become turgid and may elongate until the length is six or more times the breadth; frequently tapering to a blunt point posteriorly; neck tapering, short-conical, often reflected dorsally in turgid specimens. Ventral sucker larger than oral, average ratio about 8:5, surrounded by a raised border, which may appear to be sinuous, or may be seen to bear four or five lobes on the posterior border and about four on the anterior border, often inconspicuous in mounted material. In turgid specimens the ventral sucker may be more or less prominent, or even pedicellate. Pharynx usually a little longer than broad, and a little less than the oral sucker, average ratio about 4:5. Prepharynx very short or none; esophagus as long as or longer than pharynx. The intestines reach nearly to the posterior end, usually hidden by the dense vitellaria. Genital pores

in front of ventral sucker, to the left of the midline, the male aperture surrounded by a strong, muscular, suckerlike structure. The ejaculatory duct passes dorsal to the ventral sucker, and the seminal vesicle may extend for one-third or more of the distance between the ventral sucker and ovary. Testes, two, one following the other, and touching, or separated by a short interval filled with follicles of the vitellaria, usually rounded, circular or oval, or occasionally subtriangular in outline. Ovary at or near anterior border of first testis, not lobed, circular to elliptical in outline. Vitelline reservoir and shell gland in front of ovary; seminal receptacle not seen, probably represented by early folds of uterus. Uterus between ovary and ventral sucker; the metraterm lies beside the ejaculatory duct, dorsal to the ventral sucker, and opens at the anterior border of the genital sucker in which the ejaculatory duct opens. Vitellaria diffuse and continuous from the posterior end to the posterior border of the ventral sucker, or near it. The excretory vessel extends from the posterior end to the ovary; ova about 0.05 by 0.03 mm. The average dimensions of 24 ova, of distomes from 16 species of fishes, mostly balsam mounts, were 0.053 by 0.029 mm.; maximum 0.063 by 0.033 mm., minimum 0.045 by 0.027 mm. Twenty-one of these distomes, mounted in balsam, from 13 species of fishes, had an average length of 1.88 mm., and an average breadth of 0.37 mm.; maximum length, 3.38 mm., minimum, 0.94 mm. A living specimen slightly compressed, measured 1.57 mm. in length and 0.85 mm. in breadth; another, turgid, length, 2.1 mm., breadth, 0.35 mm.

Hosts.—Common shad (*Alosa sapidissima*), sand lance (*Ammodytes americanus*), common herring (*Clupea harengus*), squeeteague (*Cynoscion regalis*), mackerel scad (*Decapterus macarellus*), pinfish (*Lagodon rhomboides*), conger eel (*Conger conger*), rusty dab (*Limanda ferruginea*), spot (*Leiostomus xanthurus*), windowpane (*Lophopsetta maculata*), kingfish (*Menticirrhus saxatilis*), silver hake (*Merluccius bilinearis*), goatfish (*Mullus auratus*), toadfish (*Opsanus tau*), rudderfish (*Palinurichthys perciformis*), summer flounder (*Paralichthys dentatus*), four-spotted flounder (*P. oblongus*), spotted codling (*Urophycis regius*), codling (*U. tenuis*), bluefish (*Pomatomus saltatrix*), alewife (*Pomolobus pseudoharengus*), dollarfish (*Poronotus triacanthus*), common gurnard (*Merulinus carolinus*), winter flounder (*Pseudopleuronectes americanus*), bonito (*Sarda sarda*), common mackerel (*Scomber scombrus*), common pipefish (*Syriotes fuscus*), puffer (*Sphoeroides maculatus*), southern porgy (*Stenotomus chrysops*), tautog (*Tautoga onitis*), cunner (*Tautoglabrus adspersus*), round pampano (*Trachinotus falcatus*), gog-gler (*Trachurops crumenophthalma*).

Record of collections.—From shad: One, collected July 13, 1910. Measurements, life: Length, 1.75 mm., breadth, 0.52 mm.; diameter of oral sucker, 0.14 mm.; pharynx, length, 0.13 mm., breadth, 0.09 mm.; ventral sucker, length, 0.21 mm., breadth, 0.26 mm.; ova, 0.058 by 0.034 mm. One, collected July 5, 1923, by Dr. G. A. MacCallum.

From sand lance: Three, collected July 5, 1912; small, turgid, with prominent ventral suckers. Measurements, life, compressed: Length, 2.1 mm., breadth, 0.35 mm.; diameter oral sucker, 0.14 mm., of pharynx, 0.14 mm., of central sucker, 0.22 mm.; ova, 0.045 by 0.027 mm.

Recorded from common herring: Bull. U. S. Fish Comm. for 1899, p. 437, 1901.

Recorded from squeteague: Bull. U. S. Fish Comm. for 1899, p. 460, 1901.

Recorded from mackerel scad: Bull. U. S. Fish Comm. for 1899, p. 449, 1901. Nine (U.S.N.M. No. 8247), collected September and October, 1913; length, in balsam, 2.52 mm., breadth, 0.35 mm.

From pinfish: One (U.S.N.M. No. 8248) collected June 4, 1914; length, 3.6 mm., breadth, 0.67, in formalin.

Recorded from conger eel: Bull. U. S. Fish Comm. for 1899, p. 436, 1901. One, collected July 22, 1904; length, 2.5 mm., breadth, 0.65 mm., in fresh water, turgid.

Recorded from rusty dab: Bull. U. S. Fish Comm. for 1899, p. 485, 1901. Measurements in balsam: Length, 1.12 mm., breadth, 0.22 mm.; oral sucker, length, 0.11 mm., breadth, 0.1 mm.; Pharynx, length, 0.1 mm., breadth, 0.09 mm.; ventral sucker, length, 0.18 mm., breadth, 0.17 mm.; ova, 0.051 by 0.036 mm.

From spot: Collected by Vinal N. Edwards on five dates in September, nine in October, and two in November, 1912, 1913, and 1914; 225 fishes were examined and 59 distomes found. The greatest number secured on any date was ten, when 42 fishes were examined. Length, 2 to 3.5 mm. in formalin. Twenty-five or more distomes from this lot are mounted in balsam. Measurements of a typical form: Length, 2.14 mm., breadth, 0.42 mm.; oral sucker, length, 0.13 mm., breadth, 0.14 mm.; pharynx, length, 0.11 mm., breadth, 0.11 mm.; ventral sucker, length, 0.19 mm., breadth, 0.21 mm.; ova, 0.051 by 0.027 mm. (U.S.N.M. No. 8249).

From windowpane: Four, collected July 27, 1904; small, turgid, with prominent ventral suckers. Numerous (U.S.N.M. No. 8250), collected August 8 and 11, 1905; small, about 0.9 mm. in length; very various shapes; some short and broad, some flattened, others cylindrical; some with sessile, others with pedicelled ventral suckers; some with distinct papillate border surrounding the ventral sucker, in others papillae indistinct. Same variations in balsam mounts as noted in fresh material. Nine, collected July 18, 1923, found by Dr.

MacCallum on gills. They had evidently come from the stomach. Two, collected July 6, 1925, found adhering to an echinorhynchus, not noticed until after it had been in fresh water; turgid, with prominent ventral sucker and reflected neck. Measurements of distomes from this host agree with those from other hosts. Measurements of one in balsam: Length, 1.08 mm., breadth, 0.22 mm.; oral sucker, length, 0.08 mm., breadth, 0.1 mm.; pharynx, length, 0.08 mm., breadth, 0.07 mm.; ventral sucker, length, 0.2 mm., breadth, 0.15 mm.; ova, 0.051 by 0.033 mm.

From kingfish: Bull. U. S. Fish Comm. for 1899, p. 462, 1901. One (U.S.N.M. No. 8251), collected September 3, 1908. Measurements, balsam: Length, 1.86 mm.; breadth, 0.38 mm.; oral sucker, length, 0.12 mm., breadth, 0.12 mm.; pharynx, length, 0.11 mm., breadth, 0.08 mm.; ventral sucker, length, 0.18 mm., breadth, 0.18 mm.; ova, 0.051 by 0.03 mm. Two, collected September 23, 1913; length, in balsam, 1.5 mm.

From silver hake: Bull. U. S. Fish Comm. for 1899, pp. 282, 290, figs. 38, 39, 1900, p. 474, fig. 335, 1901. Three, collected August 29, 1903; small, one with ova. Three, collected August 15, 1907. Six (U.S.N.M. No. 8252), collected August 13, 1928; 1 to 1.75 mm. in length, in balsam. Two, collected August 16, 1928; length, 2 mm.; breadth, 0.46 mm., life.

From goatfish: Five, collected September 2, 1908, from an 8-cm. fish, seined in Great Harbor; lengths, 1.19 to 1.4 mm. in balsam; papillary fringe around ventral sucker distinct. Six, collected August 24, 1918, from an 11-cm. fish. Lengths in balsam, 1.4 to 3.12 mm. In one of the larger specimens it was noted that there was much variation in the size of the ova in the vicinity of the shell gland. Thus, while most of the ova in the specimen were of the usual size, a maximum of about 0.054 by 0.042 mm., the following variants were noted: 0.048 by 0.033; 0.045 by 0.033; 0.039 by 0.034; 0.033 by 0.024; 0.03 by 0.021; 0.033 by 0.018; 0.021 by 0.009 mm. Two (U.S.N.M. No. 8253), collected September 4, 1918, from a 12-cm. fish; slender; one, length, 2.59 mm., breadth, 0.4 mm.; the other, length, 4.41 mm., breadth, 0.36 mm.; ova, 0.048 by 0.027 mm.

From toadfish: One, collected September 9, 1913.

From rudderfish: One (U.S.N.M. No. 8254), collected August 19, 1929; measurements in balsam, lateral view: Length, 2.38 mm., breadth, 0.42 mm.; oral sucker, length, 0.17 mm., breadth, 0.17 mm.; pharynx, length, 0.14 mm., breadth, 0.15 mm.; ventral sucker, length, 0.27 mm., breadth, 0.24 mm.; ova, 0.51 by 0.57 mm.

From summer flounder: Bull. U. S. Fish Comm. for 1899, p. 482, fig. 336, 1901. One, collected October 19, 1903. One, collected August 9, 1904; taper-pointed posteriorly, length, 1.45 mm. One,

collected August 15, 1906; measurements, life: Length, 1.54 mm.; breadth 0.63 mm.; diameter oral sucker, 0.15 mm., of pharynx, 0.15 mm., of ventral sucker, 0.27 mm.; ova, 0.037 by 0.023 mm. Short papillae were noted behind the posterior edge of the ventral sucker.

From four-spotted flounder: One, collected August 4, 1905.

From spotted codling: Seven, collected October 19, 1908; 1.5 to 3.5 mm. in formalin. Eleven, collected October 23, 1913. Ten (U.S.N.M. No. 8255), collected November 12, 1915. Dimensions in balsam: Length 1.26 mm., breadth 0.32 mm.; oral sucker, length 0.09 mm., breadth 0.1 mm.; pharynx, length 0.08 mm., breadth 0.08 mm.; ventral sucker, length 0.15 mm., breadth 0.16 mm.; ova 0.54 by 0.27 mm.

From codling: Six, collected August 4, 1911; 3 fishes examined. Dimensions in balsam: Length 1.93 mm., breadth 0.56 mm.; oral sucker, length 0.11 mm., breadth 0.1 mm.; pharynx, length 0.1 mm., breadth 0.08 mm.; ventral sucker, length 0.21 mm., breadth 0.18 mm.; ova 0.048 by 0.027 mm. One (U.S.N.M. No. 8256), collected November 3, 1913; length in formalin 2.25 mm.; 4 fishes examined. One, collected July 30, 1929; length in balsam 1.68 mm.; 3 fishes (15–20 cm.) examined.

From bluefish: Bull. U. S. Fish Comm. for 1899, p. 451, figs. 337–339, 1901. A few, collected July 15, 1904. One, collected August 11, 1904, from intestine. One (U.S.N.M. No. 8257), collected July 1, 1910. Dimensions in balsam, lateral view: Length 3.38 mm., breadth 0.56 mm.; oral sucker, length 0.2 mm., breadth 0.15 mm.; pharynx, length 0.17 mm., breadth 0.12 mm.; ventral sucker, length 0.29 mm., breadth 0.31 mm.; ova 0.048 by 0.024 mm.; ventral sucker pedicillate, with 5 digitate lobes at its posterior border; ovary elliptical; testes triangular in outline. One, collected August 27, 1910. A few, collected July 17, 1911; one of these in balsam shows distinct lobes on anterior border of ventral sucker and less distinct lobes on posterior border. In specimens flattened, and viewed either from the dorsal or the ventral side, these lobes are difficult to distinguish.

From alewife: Bull. U. S. Fish Comm. for 1899, p. 439, 1901. One, collected July 26, 1910; length, 1.6 mm.; breadth, 0.53 mm., life, compressed. One, collected August 17, 1910; length, 1.85 mm. Eleven, collected October 19, 1914. In one specimen, mounted in balsam, lateral view, blunt papillae around the ventral sucker are plainly shown; in the others, ventral view, they are not visible. Measurements in balsam: Length, 1.46 mm., breadth, 0.43 mm.; oral sucker, length, 0.11 mm., breadth, 0.10 mm.; pharynx, length, 0.08 mm., breadth, 0.08 mm.; ventral sucker, length, 0.18 mm., breadth, 0.14 mm.; length of esophagus, 0.11 mm.; ova, 0.051 by 0.027 mm.

From dollarfish: 20 (U.S.N.M. No. 8258), collected July 18, 1923; small, slender distomes, tapering anteriorly and posteriorly, with four short papillae on both anterior and posterior borders of the ventral sucker; length, free in sea water, 1.5 mm.; diameter, lateral view, maximum, 0.11 mm., near posterior end, 0.07 mm.; diameter of oral sucker, 0.09 mm., of ventral sucker, 0.15 mm.; ova, 0.042 by 0.024 mm. The testes vary from subtriangular to oval-elliptical in outline.

Measurements in balsam (lateral view): Length, 1.54 mm., breadth, 0.18 mm.; oral sucker, length, 0.11 mm., breadth, 0.08 mm.; pharynx, length, 0.1 mm., breadth, 0.06; ventral sucker, length, 0.17 mm., breadth, 0.18 mm.; ova, 0.048 by 0.024 mm.

TABLE 18.—*Measurements of the testes in five specimens of Cymbophallus vitellus*

| Testis | 1 | | 2 | | 3 | | 4 | | 5 | |
|------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| | Length | Breadth | Length | Breadth | Length | Breadth | Length | Breadth | Length | Breadth |
| First..... | <i>Mm.</i> 0.08 | <i>Mm.</i> 0.08 | <i>Mm.</i> 0.07 | <i>Mm.</i> 0.13 | <i>Mm.</i> 0.10 | <i>Mm.</i> 0.13 | <i>Mm.</i> 0.14 | <i>Mm.</i> 0.07 | <i>Mm.</i> 0.14 | <i>Mm.</i> 0.11 |
| Second.... | .13 | .08 | .08 | .13 | .13 | .10 | .17 | .07 | .15 | .18 |

From common gurnard: One (U.S.N.M. No. 8259), collected August 28, 1907. Measurements in balsam: Length, 1.54 mm., breadth, 0.31 mm.; oral sucker, length, 0.13 mm., breadth, 0.11 mm.; pharynx, length, 0.11 mm., breadth, 0.08 mm.; ventral sucker, length, 0.21 mm., breadth, 0.18 mm.; ova, 0.05 by 0.03; length of esophagus, 0.13 mm. About four short papillae on anterior border of ventral sucker.

From winter flounder: Bull. U. S. Fish Comm. for 1899, p. 486, fig. 340, 1901.

From bonito: Bull. U. S. Fish Comm. for 1899, p. 446, 1901. One, collected July 25, 1904.

From common mackerel: Bull. U. S. Fish Comm. for 1899, p. 445, 1901. Two, collected July 20, 1918; from stomach of a mackerel about 25 cm. in length. Slender, tapering from level of testes to each end; esophagus a little longer than pharynx; characteristic lobes around ventral sucker well shown in one. Measurements in balsam: Length, 1.54 mm.; breadth, 0.4 mm.; oral sucker, length, 0.13 mm., breadth, 0.13 mm.; pharynx, length, 0.11 mm., breadth, 0.1 mm.; ventral sucker, length, 0.24 mm., breadth, 0.24 mm.; ova, 0.051 by 0.03.

Certain small distomes, most of them less than 1 mm. in length, but containing ova, from young mackerel, 18 to 27 mm. in length, collected in July and August, 1918, 1919, and agreeing closely with this species, are here recorded. Measurements in balsam: Length, 1.34 mm., breadth, 0.46 mm.; oral sucker, length, 0.14 mm., breadth,

0.17 mm.; pharynx, length, 0.12 mm., breadth, 0.11 mm.; ventral sucker, length, 0.18 mm., breadth, 0.22 mm.; ova, 0.045 by 0.024 mm.

From common pipefish: Ten, collected July 29, 1913; three fish examined; collected by Dr. G. A. MacCallum. One (U.S.N.M. No. 8260), collected June 13, 1914. Measurements in balsam: Length, 2.10 mm., breadth, 0.38 mm.; diameter oral sucker, 0.13 mm., of ventral sucker, 0.25 mm.; pharynx, length, 0.13 mm., breadth, 0.10 mm.; ova, 0.054 by 0.027 mm. Posterior end bluntly rounded; the seminal vesicle extends nearly half-way from ventral sucker to ovary.

From puffer: Bull. U. S. Fish Comm. for 1899, p. 464, 1901. One, collected August 16, 1906. Length in balsam, 1.4 mm.; breadth, 0.49 mm. Three small distomes (U.S.N.M. No. 8261), collected August 21, 1918, from a 20 mm. fish. Length, life, 0.70 mm. (Fig. 20). Measurements in balsam: Length, 0.52 mm.; breadth, 0.31 mm.; oral sucker, length, 0.08 mm., breadth, 0.11 mm.; pharynx, length, 0.09 mm., breadth, 0.09 mm.; ventral sucker, length, 0.17 mm., breadth, 0.18 mm.; ova, 0.042 by 0.021 mm. Resemble small distomes from mackerel; elliptical, strongly contracted; anatomy much obscured by vitellaria, which extend from posterior end to middle of ventral sucker; muscular genital pore at left of pharynx. These distomes resemble *Distomum* sp., from *Opsanus tau* (Bull. U. S. Fish Comm. for 1899, p. 469, fig. 328, 1901).

From southern porgy: Bull. U. S. Fish Comm. for 1899, p. 458, figs. 333, 334, 1901. One, collected August 1, 1904. One, collected August 22, 1910. Ventral sucker prominent, with characteristic undulate or papillate border; genital sucker seen distinctly, with metraterm opening in front of it.

From tautog: One, collected August 12, 1904; under slight pressure, length, 1 mm.; breadth, 0.45 mm.; after killing over flame, under pressure, length, 1.54 mm., breadth, 0.41 mm.

A few, collected August 15, 1908; three mounted in balsam. These taper to a blunt point posteriorly. Measurements, lateral view: Length, 1.26 mm., breadth, 0.20 mm.; diameter of oral sucker, 0.10 mm.; pharynx, length, 0.08 mm., breadth, 0.05 mm.; ventral sucker, length, 0.16 mm., breadth, 0.15 mm.; ova, 0.051 by 0.030 mm. Nine, collected July 5, 1910; variety of shapes. It was noted that two of these distomes differed from the others in having subtriangular testes, the juxtaposed edges of which were diagonal instead of horizontal. The posttesticular region of one was short and bluntly rounded, the other tapered to a blunt point. Length of one, 1.26 mm.; breadth, 0.49 mm.; the other, length, 1.05 mm., breadth, 0.31 mm. The others in this lot measured from 1.12 to 2.66 mm. in length. Two, collected August 2, 1911; before flattening one of these was elongated and fili-

form, the other rather slender and pointed posteriorly, each with characteristic ventral sucker. Seventeen (U.S.N.M. No. 8262), collected October 23, 1913; length, 1.5 mm., to 2.75 mm. in formalin. One, collected May 4, 1914; length, 3 mm. Fifteen, collected October 10, 1916; longest about 2.5 mm. in formalin.

TABLE 19.—*Measurements of three distomes of Cymbophallus vitellosus from the tautog, showing diversity of proportions*

| Measurement | 1 | 2 | 3 |
|----------------------------------|------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 0.87 | 1.15 | 2.87 |
| Diameter at anterior end..... | .07 | .11 | .18 |
| Diameter at middle..... | .22 | .43 | .56 |
| Diameter near posterior end..... | .08 | .34 | .30 |

From cunner: Bull. U. S. Fish Comm. for 1899, p. 462, 1901. Three, collected August 15, 1905, small. One, collected August 22, 1905, length, 1.23 mm. in balsam. Seven (U.S.N.M. No. 8263), collected July 17, 1919; length, 1.5 mm. to 2.8 mm. in balsam. The vitellaria in the distomes of this lot are less dense than usual for this species, and the intestines could be traced to the posterior end. The metratrum could be seen opening in front of the genital sucker. Measurements in balsam: Length, 2.80 mm., breadth, 0.52 mm.; oral sucker, length, 0.16 mm., breadth, 0.15 mm.; pharynx, length, 0.15 mm., breadth, 0.12 mm.; ventral sucker, length, 0.28 mm., breadth, 0.25 mm.; ova, 0.048 by 0.027 mm.

From round pampano: Three (U.S.N.M. No. 8264), collected September 2, 1903, from a 20-mm. fish. Small, less than 1 mm. in length, strongly contracted; average length, 0.92 mm., breadth, 0.44 mm.; vitellaria to middle of ventral sucker; prominent border around ventral sucker. Measurements in balsam: Length, 0.91 mm., breadth, 0.50 mm.; oral sucker, length, 0.13 mm., breadth, 0.15 mm.; pharynx, length, 0.12 mm., breadth, 0.15 mm.; ventral sucker, length, 0.17 mm., breadth, 0.24 mm.; ova, 0.048 by 0.030 mm.

From goggler: Five (U.S.N.M. No. 8265), collected August 29, 1913; length, 3.38 mm., breadth, 0.30 mm., life. Measurements in balsam: Length, 2.66 mm., breadth, 0.42 mm.; diameter oral sucker, 0.15 mm., of pharynx, 0.10 mm., of ventral sucker, 0.18 mm.; ova, 0.054 by 0.027 mm. One, collected September 17, 1914; length, 2.17 mm. in formalin. Metratrum seen opening about on level of posterior end of pharynx and in front of the genital sucker; seminal vesicle to about one third the distance from ventral sucker to ovary; papillae around ventral sucker.

CYMBEPHALLUS FIMBRIATUS Linton

PLATE 2, FIGURES 13-17

Distomum vitellosum LINTON, Bull. U. S. Fish Comm. for 1899, p. 428, 1901; Bull. Bur. Fisheries, vol. 24, pp. 388, 390, figs. 176-178, 1905.

Cymbephallus fimbriatus LINTON, Journ. Washington Acad. Sci., vol. 24, p. 82, 1934.

Body elongate, not varying much in diameter; neck short, more or less conical; ventral sucker larger than oral, prominent, sometimes pedicelled, surrounded by a raised border, with many short papillae; pharynx longer than broad; esophagus longer than pharynx; intestines extend to posterior end; genital pore in front of ventral sucker, to left of median line, the opening of the ejaculatory duct a muscular genital sucker; opening of metraterm, with sphincter, on a blunt papilla at anterior border of genital sucker; seminal vesicle elongate, curved, extending to from one third to more than one half the distance between the ventral sucker and the ovary; testes two, one following the other, with but a short interval between, in some cases lobed. Ovary at or near interior border of first testis, usually not lobed, although a tendency toward a lobed condition was observed in a few cases; shell-gland at anterior border of ovary. No seminal receptacle seen; in one specimen sperm was seen in front of the shell gland, where it appeared to be lying in the early folds of the uterus. Vitelline reservoir at the dorsal, anterior border of the ovary; vitellaria diffuse, filling the body back of the testes, and along the margins, not usually interrupted opposite the testes, and extending to a point about half-way between the ovary and ventral sucker; uterus between ovary and ventral sucker; ova about 0.06 by 0.03, in balsam.

TABLE 20.—Measurements of five specimens of *Cymbephallus fimbriatus* in balsam

| Measurement | 1 | 2 | 3 | 4 | 5 |
|-------------------------------|------------|------------|------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 3.78 | 3.92 | 4.34 | 4.62 | 3.70 |
| Maximum breadth | .53 | .67 | .49 | .56 | .56 |
| Oral sucker, length | .26 | .26 | .17 | .26 | .19 |
| Oral sucker, breadth | .26 | .22 | .14 | .21 | .15 |
| Pharynx, length..... | .14 | .15 | .13 | .15 | .14 |
| Pharynx, breadth | .07 | .08 | .08 | .09 | .07 |
| Ventral sucker, length..... | .28 | .32 | .21 | .35 | .28 |
| Ventral sucker, breadth | .28 | .32 | .28 | .35 | .28 |
| Ova, 0.06 by 0.03. | | | | | |

This species differs from *C. vitellosus* in its larger size, and in having longer and more numerous papillae around the ventral sucker, in the more or less lobed testes, and the larger ova, and in the relatively longer seminal vesicle. Also, while *C. vitellosus* in many

instances tends to taper from the middle toward the posterior end, *C. fimbriatus* as a rule maintains a uniform breadth back of the ventral sucker and is bluntly rounded at the posterior end. There are, however, many contraction shapes in both species, so that it is difficult to fit descriptions to them.

The ova are rather thin-shelled, and are much collapsed in all the balsam mounts. In six distomes, averaging 3.49 mm. in length, the average distance of the posterior end of the seminal vesicle from the ventral sucker was 0.78 mm. and from the ovary 0.074 mm.

Host.—Kingfish (*Menticirrhus saxatilis*).

Record of collections.—One (U.S.N.M. No. 8266), collected September 11, 1907. Measurements, life: Length, 1.28 mm.; breadth, 0.60 mm.; diameter of oral sucker, 0.12 mm., of pharynx, 0.07 mm., of ventral sucker, 0.028 mm.; ova, 0.061 by 0.034 mm.

One, collected September 8, 1909; length, 4 mm.

Three, collected June 29, 1910; one, collected July 7, 1910; seven, collected July 27, 1910. When first examined these distomes had been lying in sea water for several hours. They were, with one exception, turgid, longest 7 mm. One, still active, was yellowish green by transmitted light, crossed by fine, transverse wrinkles; length, 1.9 mm., breadth, 0.70 mm. After flattening under cover-glass, length, 3.7 mm.; breadth, 0.84 mm.

Two, collected August 10, 1910. One, collected October 31, 1912; turgid, neck reflected at right angles to body; length, 3.5 mm. in formalin. Two, collected September 23, 1914; length, 2.5 mm. and 3 mm. Three, collected July 21, 1926, macerated.

Genus *LEPOCREADIUM* Stossich, 1906

LEPOCREADIUM PYRIFORME (Linton)

PLATE 5, FIGURES 47-49

Distomum pyriforme LINTON, Bull. U. S. Fish Comm. for 1900, pp. 292, 293, figs. 52-59, 1900 (from *Palinurichthys perciformis*); *ibid.*, pp. 453, 458, fig. 346 (*Distomum* sp.), 1901.

To this species are referred certain small distomes which, although differing in many details of structure, resemble each other sufficiently to warrant their inclusion in the same specific grouping when allowance is made for such differences as may be accounted for by varying conditions of contraction and age. In general they are small, spinose distomes, with suckers about the same size, pharynx small, prepharynx and esophagus present; genital pore in front of ventral sucker to left of median line; prostate and first seminal vesicle enclosed in cirrus pouch; a second seminal vesicle connected with the cirrus pouch by a short vas deferens, often masked by the ova; testes, one following the other; ovary in front of first testis, not

lobed. The diffuse vitellaria extend to, and often in front of the ventral sucker.

Hosts.—Sand launce (*Ammodytes americanus*), squeteague (*Cynoscion regalis*), kingfish (*Menticirrhus saxatilis*), rudderfish (*Palinurichthys perciformis*), harvestfish (*Peprilus paru*), bluefish (*Pomatomus saltatrix*), dollarfish (*Poronotus triacanthus*), southern porgy (*Stenotomus chrysops*), cutlassfish (*Trichiurus lepturus*).

Record of collections.—From sand launce: Two, collected July 5, 1912. Measurements in balsam: Length, 0.91 mm., breadth, 0.29 mm.; diameter of oral sucker, 0.07 mm., of pharynx, 0.04 mm., of ventral sucker, 0.05 mm.; length of prepharynx, 0.02 mm., of esophagus, 0.03 mm.; ova, 0.060 by 0.036 mm. In one of these the oral sucker was retracted. Metratrem with relatively thick walls; genital pore at anterior border of ventral sucker nearly median; globular concentric bodies in excretory vessels; vitellaria from posterior end along margins to a level halfway between ventral sucker and pharynx. Two (U.S.N.M. No. 8267), collected November 1, 1913. Thirty fishes examined. Length in balsam, 2.24 mm.; breadth, 0.66 mm. Seven, collected October 20, 1914. One hundred fishes examined.

From squeteague: Bull. U. S. Fish Comm. for 1899, p. 460, 1901.

From kingfish: Bull. U. S. Fish Comm. for 1899, p. 462, 1901.

From rudderfish: Distomes from this host were first described under the name *Distomum pyriforme*, see above. Fifteen, collected August 18, 1903; three fishes examined; largest specimens, life, length 1.12 mm., smallest 0.24 mm. Forty (U.S.N.M. No. 8268), collected August 7, 1928. Small, densely and finely spinose, spines, more or less evanescent. Ovate to elliptical-oblong; suckers nearly equal; prepharynx and esophagus each as long or longer than pharynx; intestines reach nearly to posterior end; genital pore in front of ventral sucker, a little to left of median line; cirrus-bulb dorsal to ventral sucker, its posterior end, enclosing a seminal vesicle, extending back of the ventral sucker; behind the cirrus pouch a second seminal vesicle connected with it by a short vas deferens; testes two, one following the other with little or no interval between, in posterior third of body; ovary in front of first testis, a little to the right of the median line, not lobed; uterus in front of ovary, ova few and relatively large; metratrem on left side of cirrus bulb; vitellaria from posterior end to, and in some cases in front of, ventral sucker; shell gland on left of ovary; yolk reservoir along anterior border of first testis; seminal receptacle between first testis and ovary, dorsal to yolk reservoir. Measurements in balsam: Length, 0.84 mm.; breadth, 0.22 mm.; oral sucker, length, 0.42 mm., breadth, 0.59 mm.; pharynx, length, 0.36 mm., breadth, 0.39 mm.;

ventral sucker, length, 0.57 mm., breadth, 0.57 mm.; length of prepharynx, 0.45 mm., of esophagus, 0.51 mm.; ova, 0.054 by 0.030 mm.

From bluefish: *Distomum* sp., Bull. U. S. Fish Comm. for 1899, p. 451, figs. 341-344, 1901.

From dollarfish: Small, spinose distomes from the dollarfish, agreeing in most particulars with this species are here recorded. See also Bull. U. S. Fish Comm. for 1899, pp. 454, 455, fig. 353, 1901. One, collected August 13, 1904; length, life, 1.28 mm., breadth, 0.28 mm.; prepharynx and esophagus but little longer than pharynx; concentric bodies in excretory vessels, 0.02 mm. in diameter. One, collected July 2, 1907. Measurements in balsam: Length, 0.96 mm.; breadth, 0.31 mm.; diameter of oral sucker, 0.06 mm., of pharynx, 0.04 mm., of ventral sucker, 0.06 mm.; ova, 0.054 by 0.027 mm. Concentric bodies in excretory vessels of living worm; prepharynx and esophagus short.

An immature distome, found in a mass of appendicularia in the stomach of this dollarfish, probably belongs here. It was minutely spinose and very changeable in shape. Measurements, life: Length, 0.18 mm.; maximum breadth at about the posterior third, 0.18 mm.; diameter of oral sucker, 0.04 mm., of ventral sucker, 0.03 mm., of concentric bodies in excretory vessels, 0.01 mm.

Forty-two, collected August 30, 1917, from a 72-mm. dollarfish. Two in life measured, the one 0.7 mm. in length and 0.45 mm. in breadth, the other 0.35 mm. in length and 0.18 mm. in breadth. Measurements in balsam: Length, 0.60 mm., breadth, 0.21 mm.; diameter of oral sucker, 0.05 mm., of ventral sucker, 0.05 mm.; pharynx, length, 0.04 mm., breadth, 0.03 mm.; ova, 0.051 by 0.033 mm.

Five, collected July 8, 1918, from an 85-mm. dollarfish.

One, collected July 25, 1918, from a 12-mm. dollarfish. The prepharynx and esophagus are short; in other respects it is in close agreement with distomes from the rudderfish.

Two, collected August 21, 1918, from a 12-mm. dollarfish. The prepharynx and esophagus are short; in other respects it is in close agreement with distomes from the rudderfish.

Two, collected August 21, 1918, from a 125-mm. dollarfish. On account of the retraction of the oral sucker no prepharynx could be seen, but there was a distinct esophagus. A second seminal vesicle could be made out.

From bonito: One (U.S.N.M. No. 8270), collected August 11, 1906. Measurements in balsam: Length, 1.22 mm.; breadth, 0.44 mm.; oral sucker, length, 0.75 mm., breadth, 0.57 mm.; pharynx, length, 0.05 mm., breadth, 0.06 mm.; diameter of ventral sucker, 0.75 mm.; ova, 0.056 by 0.027 mm. Prepharynx short, esophagus about as long as pharynx. The vitellaria extend in front of the ventral sucker. This distome is in close agreement with those from the rudderfish.

From southern porgy: *Distomum* sp., Bull. U. S. Fish Comm. for 1899, p. 296, fig. 72; p. 458, fig. 376, 1901. One, collected August 19, 1903. Measurements in balsam: Length, 0.65 mm.; breadth, 0.31 mm.; diameter of oral sucker, 0.07 mm., of ventral sucker, 0.07 mm.; pharynx, length, 0.05 mm., breadth, 0.04 mm.; ova, 0.068 by 0.032 mm. This distome agrees with the foregoing closely, but the esophagus is very short, and no prepharynx could be seen. The neck was strongly contracted.

Ten (U.S.N.M. No. 8271) collected August 24, 1910; six porgies examined. One, active in sea water, varied in length from 0.42 to 0.84 mm. An average of six gave the diameter of the oral sucker, 0.065, ventral sucker, 0.059 mm. In a lot of ten, mounted in balsam, there were noted cases with distinct prepharynx, and very short, or no esophagus; others with very short, or no prepharynx and distinct esophagus; others with both prepharynx and esophagus distinct. The vitellaria extend to level of posterior end of pharynx. In details of the anatomy these distomes are in close agreement with those from the rudderfish.

From cutlassfish: Thirty (U.S.N.M. No. 8272), collected June 18, 1913, from one fish. Length of longest, in formalin, 2.15 mm.; breadth, 0.6 mm. Eleven mounted in balsam vary from length, 0.6 mm. and breadth, 0.27 mm., to length, 1.26 mm., and breadth, 0.4 mm. Measurements of one of largest in balsam: Length, 1.20 mm., breadth, 0.42 mm.; diameter of oral sucker, 0.075 mm., of pharynx, 0.033 mm., of ventral sucker, 0.072 mm.; length of prepharynx, 0.015 mm., of esophagus, 0.18 mm.; ova, collapsed, about 0.06 by 0.024 mm.

The prepharynx is shorter than the pharynx and the esophagus varies from less than the length of the pharynx to twice its length or more. The vitellaria in all cases extend as far forward as the level of the ventral sucker. A second seminal vesicle was distinguished in one. So far as can be made out the anatomy of these distomes agrees closely with those from the rudderfish.

LEPOCREADIUM RETRUSUM, new species

PLATE 6, FIGURES 50-52

Body spinose, of nearly same breadth throughout, tapering slightly to anterior end, which is bluntly rounded; posterior end broadly rounded; oral sucker more or less retracted in all cases seen, smaller than ventral sucker; pharynx small, prepharynx longer than pharynx; esophagus about as long as pharynx; genital pore in front of ventral sucker, a little to left of median line; cirrus pouch large, extending back of ventral sucker and enclosing prostatic cells and a seminal vesicle; a second seminal vesicle connected with the cirrus bulb by a

short vas deferens, as in other species of this genus; testes two, one following the other, nearly contiguous, at about the posterior fourth of the length; ovary lobed, in front of first testis, a little to right of median line; seminal receptacle between ovary and first testis; uterus in front of ovary; metraterm thick-walled, on left side of cirrus pouch; vitellaria diffuse, from posterior end nearly to ventral sucker.

Type specimens.—Holotype, U.S.N.M. No. 8273; paratypes, No. 8274.

Host.—Chub mackerel (*Pneumatophorus gres*).

Record of collections.—One (U.S.N.M. No. 8273), collected July 31, 1928. Measurements in balsam: Length, 2.38 mm., breadth, 0.59 mm.; diameter of oral sucker, about 0.08 mm., of pharynx, 0.06 mm., of ventral sucker, 0.15 mm.; length of prepharynx, 0.17 mm., of esophagus, 0.06 mm.; ova, 0.06 by 0.03 mm.

Four (U.S.N.M. No. 8274), collected August 29, 1928. Measurements in balsam: Length, 1.12 mm., breadth, 0.35 mm.; diameter of oral sucker, about 0.09 mm., of pharynx, 0.03 mm., of ventral sucker, 0.12 mm.; ova, 0.054 by 0.030 mm.

LEPOCREADIUM TRULLAFORME, new species

PLATE 6, FIGURES 53-56

Distomum areolatum Rudolphi, LINTON, Bull. U. S. Fish Comm. for 1899, pp. 279, 293, 294, figs. 60-63, 1900; *ibid.*, pp. 456, 462, 486, 487, fig. 351, 1901.

Small distomes, more or less oval in outline, densely spinose anteriorly; oral and ventral suckers about equal; prepharynx and esophagus present, but, so far as observed, not exceeding the pharynx in length; intestines extend nearly to posterior end; genital pore in front of ventral sucker a little to left of median line; cirrus pouch extending back of ventral sucker, enclosing the prostate and a seminal vesicle, followed by a second seminal vesicle; testes two, near together, at about posterior third, obliquely placed. Ovary, in some cases slightly lobed, to right of median line in front of second testis; seminal receptacle in front of first testis and on the left of the ovary; uterus between testes and ventral sucker, ova few and large; metraterm to left of cirrus pouch; vitellaria diffuse, extending in front of ventral sucker.

Type specimens.—U. S. N. M. No. 8276 (holotype and paratypes).

Hosts.—American sole (*Achirus fasciatus*), long-spined sculpin (*Acanthocottus octodecimspinosus*), kingfish (*Menticirrhus saxatilis*), white perch (*Morone americana*), winter flounder (*Pseudopleuronectes americanus*), cunner (*Tautoglabrus adspersus*).

Record of collections.—*Distomum* sp., Bull. U. S. Fish Comm. for 1899, p. 487, fig. 351, 1901. Two (U.S.N.M. No. 8275) from American sole, collected October 14, 1915. While the anatomy is rather

indistinctly shown in the balsam material, so far as it can be made out it is in close agreement with distomes from *Morone americana*. The prepharynx is short, the esophagus about as long as the pharynx; genital pore in front of ventral sucker and a little to the left of the median line; cirrus smooth; testes obliquely placed. Ovary circular in outline; ova two in each, large; vitellaria extend forward to level of pharynx. Measurements of larger specimen in balsam: Length, 0.87 mm., breadth, 0.39 mm.; diameter of oral sucker, 0.1 mm., of pharynx, 0.045 mm., of ventral sucker, 0.06 mm.; ova, 0.096 by 0.066 mm.

From long-spined sculpin: Five, collected December 22, 1906. Two, collected May 12, 1913; 20 fishes examined. Fourteen, collected April 20, 1914; 2 fishes examined. Four (U.S.N.M. No. 8276), collected April 26, 1915; 12 fishes examined.

The anatomy of these distomes is imperfectly shown mainly on account of the diffuse vitellaria which mask the other genitalia; so far as the anatomy can be made out it is in agreement with that of the distomes from *M. americana*. They differ in their consistent fusiform shape. The neck was much contracted so that the pharynx and adjacent structures were much obscured. In one a prepharynx could be seen which was about equal in length to the pharynx. Testes oblique; ovary in front of testes to right of median line. A seminal receptacle was noted in front of the first testis to the left of the ovary; ova few, large, posterior and dorsal to ventral sucker; vitelline follicles coarse, extending in front of ventral sucker. Measurements in balsam: Length, 1.4 mm.; breadth, 0.56 mm.; diameter of oral sucker, 0.14 mm., of pharynx, 0.07 mm., of ventral sucker, 0.14 mm.; ova, 0.10 by 0.05 mm.

From kingfish: One (U.S.N.M. No. 8277), collected September 11, 1907. Length, life, 1.12 mm.; breadth, 0.77 mm. Measurements, balsam: Length, 1 mm.; breadth, 0.5 mm.; oral sucker, length, 0.12 mm., breadth, 0.13 mm.; pharynx, length, 0.06 mm., breadth, 0.05 mm.; ventral sucker, length, 0.09 mm., breadth, 0.11 mm.; ova, 0.12 by 0.06 mm. This is a small, pyriform distome, densely spinose anteriorly, the spines continuing to near the posterior end. The anatomy is in close agreement with distomes from *M. americana*; prepharynx and esophagus short; genital pore near median line; ova few; what was interpreted to be the second seminal vesicle lay on the left side of the ovary, in front of the seminal receptacle, apparently crowded to the right by the ova.

Small distomes from young kingfish, collected August 21, 1918, are here recorded.

One (U.S.N.M. No. 8278) from a 55-mm. fish; 3 from a 100-mm. fish; 16 from a 105-mm. fish; 20 from a 110-mm. fish. These are

small, oval-elliptical distomes, varying from a length of 0.22 mm. with a breadth of 0.15 mm., to length 0.45 mm., with a breadth of 0.28 mm.; minutely and densely spinose at anterior end, spines becoming sparse toward posterior end; oral sucker larger and more muscular than ventral; pharynx about as broad as long, much smaller than oral sucker; prepharynx and esophagus very short; intestines reach to posterior end; cirrus and cirrus-pouch dorsal to ventral sucker, seminal vesicle extending back of ventral sucker; genital pore at anterior edge of ventral sucker, a little to left of median line; testes diagonal, nearly transverse in one, about midway between ventral sucker and posterior end; ovary to right of median line in front of right testis; yolk reservoir between ovary and right testis, best seen in dorsal view; shell gland ventral to left side of yolk reservoir, extending to median line; seminal receptacle dorsal to anterior border of left testis; a second seminal vesicle was faintly indicated dorsal to the shell gland; ova very few, one or two, between testes and ventral sucker; vitellaria diffuse, from posterior end to oral sucker; posterior excretory vessel large. A characteristic feature of these distomes is the large size and small number of the ova. No more than two ova were seen (in any one of them. Some of the smallest were immature, and contained no ova, but ova were present in quite small specimens. Thus, one, length, 0.28 mm., breadth, 0.27 mm., contained one ovum 0.10 by 0.06 mm.; another, length, 0.28 mm., breadth, 0.25 mm., contained two ova, 0.10 by 0.05 mm. and 0.10 by 0.06 mm. Measurements of one in balsam: Length, 0.42 mm.; breadth, 0.36 mm.; oral sucker, length, 0.09 mm., breadth, 0.10 mm.; pharynx, length, 0.05 mm., breadth, 0.05 mm.; ventral sucker, length, 0.06 mm., breadth, 0.06 mm.; ova, 0.10 by 0.06 mm.

From white perch: Eight (U.S.N.M. No. 8279), collected August 8, 1910. Six fishes examined. Measurements, life, moderately compressed: Length, 1.04 mm.; breadth, 0.05 mm.; oral sucker, length, 0.1 mm., breadth, 0.11 mm.; pharynx, length, 0.06 mm., breadth, 0.04 mm.; ventral sucker, length, 0.10 mm., breadth, 0.09 mm.; ova, 0.11 by 0.07 mm.; ova 5 in number. Prepharynx and esophagus each shorter than pharynx; genital pore to left of median line; a second seminal vesicle noted; testes oblique; yoke reservoir between testes and ovary; seminal receptacle near median line in front of testes; shell gland in front of seminal receptacle; ovary in one appeared to be slightly lobed; vitellaria extend about to level of pharynx.

From winter flounder: *Distomum areolatum* Rudolphi, Bull. U. S. Fish Comm. for 1899, 1901.

From cunner: *Distomum areolatum* Rudolphi, Bull. U. S. Fish Comm. for 1899, 1901. A reexamination of these distomes shows that they belong here. They are densely spinose, broadest about the

middle of the length, tapering rather uniformly to bluntly rounded ends; prepharynx short, esophagus about as long as pharynx; testes oblique; ova few; vitellaria extend nearly to pharynx; genital pore about halfway between ventral sucker and pharynx, a little to left of median line; cirrus pouch extending back of ventral sucker. Measurements, balsam: Length, 1.06 mm., breadth, 0.49 mm.; breadth of oral sucker, 0.15 mm., of pharynx, 0.06 mm., of ventral sucker, 0.13 mm.; ova, 0.126 by 0.078. (U.S.N.M. No. 8280.)

Genus **LEPIDAPEDON** Stafford, 1904

LEPIDAPEDON CLAVATUM, new species

PLATE 4, FIGURES 36, 37

Body thickish, body more or less terete; neck and anterior part of body covered with dense, minute spines; tapering gradually to anterior end, and more or less abruptly to posterior end; oral sucker subterminal, pharynx relatively large, ventral sucker larger than oral; prepharynx approximately as long as pharynx, varying with state of contraction of neck; esophagus short, if any, intestines extend to posterior end; genital pore in front of ventral sucker, median or nearly so; cirrus pouch short, muscular, at anterior edge of ventral sucker; testes two, relatively large, more or less rounded, close together, one following the other, at about the posterior third, the second testis a little more than its length from the posterior end; ovary at anterior border of first testis; uterus between ovary and ventral sucker; ova not numerous, relatively large, for the most part clustered behind the ventral sucker; vitellaria diffuse, follicles coarse, from the posterior end to within a short distance of the ventral sucker.

One specimen from *Lophopsetta maculata* and four from *Ceratacanthus schoepfi* suggest *L. rachion*, but in each of them the ventral sucker is distinctly larger than the oral.

Type specimens.—Holotype, U.S.N.M. No. 8281; paratypes, No. 8282.

Hosts.—Filefish (*Ceratacanthus schoepfi*) and windowpane (*Lophopsetta maculata*).

Record of collections.—From filefish: One, collected August 7, 1905. Measurements, lateral view, in glycerin: Length, 3.5 mm.; maximum breadth, 0.84 mm.; oral sucker, length, 0.22 mm., breadth, 0.28 mm.; pharynx, length, 0.22 mm., breadth, 0.29 mm.; ventral sucker, 0.37 mm., breadth, 0.35 mm.; ova, 0.08 by 0.04 mm.

One (U.S.N.M. No. 8281), collected July 29, 1908.

Two (U.S.N.M. No. 8282), collected August 21, 1915. Body terete, nearly linear, greatest breadth at level of testes, tapering gradually

to anterior, and more abruptly to posterior end. While the seminal vesicle, so far as it is shown in the mounted specimens, is in front of the ventral sucker, in one specimen it appears to be somewhat crumpled, elongated, in front and on the right dorsal side of the ventral sucker, narrowing slightly until near the level of the anterior border of the sucker, where it expands from a diameter of 0.03 mm. into an enlarged portion 0.28 mm. in length and 0.13 mm. in diameter, the anterior half of which is contiguous with the cirrus pouch. The ovary appeared to be slightly lobed in one specimen, circular in outline in at least one, and oval-elliptical, with the longer diameter transverse, in one.

TABLE 21.—Measurements of four specimens of *Lepidapedon clavatum* in balsam

| Measurement | 1 | 2 | 3 | 4 |
|------------------------------|------------|------------|------------|---------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 3.50 | 3.25 | 3.50 | 3.78 |
| Maximum breadth..... | .81 | .62 | .84 | .84 |
| Oral sucker, length..... | .17 | .17 | .28 | .31 |
| Oral sucker, breadth..... | .28 | .28 | .27 | .28 |
| Pharynx, length..... | .21 | .21 | .28 | .28 |
| Pharynx, breadth..... | .21 | .21 | .28 | .29 |
| Ventral sucker, length..... | .35 | .38 | .39 | .37 |
| Ventral sucker, breadth..... | .35 | .38 | .42 | .35 |
| Ova..... | | | | .078 by 0.045 |

From windowpane: One (U.S.N.M. No. 8283), collected August 17, 1908. Measurements in balsam: Length, 3.64 mm., breadth, 0.70 mm.; oral sucker, length, 0.28 mm., breadth, 0.35 mm.; pharynx, length, 0.29 mm., breadth, 0.29 mm.; ventral sucker, length, 0.47 mm., breadth, 0.5 mm.; length of prepharynx, 0.28 mm.; ova, 0.075 by 0.045 mm. This specimen agrees closely with the distomes from *Ceratacanthus schoepfi*. The body is nearly linear, tapering to a moderately blunt point at the posterior end; neck nearly linear. Length of spines on neck about 0.015 mm. Seminal vesicle with a few prostate cells at right margin of cirrus pouch; ovary slightly lobed; shell gland in front of ovary; no seminal receptacle seen, but some indication of sperm in early folds of uterus.

LEPIDAPEDON ELONGATUM (Lebour)

PLATE 5, FIGURES 38-45

Lepodora elongata LEBOUR, Rep. (1907) Northumberland Sea Fisheries, pp. 20-21, 1908.

Lepidapedon elongatum (Lebour), MANTER, Illinois Biol. Mon., vol. 10, No. 2, pp. 85, 86, figs. 47, 48, 1926.

Distomes from seven species of Woods Hole fishes, while presenting many differences in minor details of structure, are referred to

this species. They are elongated forms differing from *L. rachion* in having a relatively smaller pharynx, and in having both the prepharynx and esophagus as long, or longer, than the pharynx. The testes are usually separated from each other by a longer or shorter interval in which follicles of the vitellaria appear.

Details of structure are given in the records of collections.

Hosts.—Four-bearded rockling (*Enchelyopus cimbrius*), common codfish (*Gadus morrhua*), pollack (*Pollachius virens*), summer flounder (*Paralichthus dentatus*), codling (*Urophycis chuss*), goggler (*Trachurops crumenophthalma*).

Record of collections.—From four-bearded rockling. *Distomum* sp., Bull. U. S. Fish Comm. for 1899, p. 479, fig. 330, 1901.

From common codfish: Eight, collected December 21, 1903; 24 fishes examined.

Thirteen, collected December 13, 1905; 50 fishes examined. Measurements in formalin: Length 1.6 mm., breadth 0.28 mm., nearly linear. One, collected November 12, 1912; 5 fishes examined. One, collected November 15, 1912; 3 fishes examined. Fourteen, collected December 28, 1912; 25 fishes examined. Two, collected December 30, 1912; 15 fishes examined. Measurements of one in formalin: Length 2.8 mm., breadth 0.42 mm.; diameter of oral sucker 0.10, of pharynx 0.06, of ventral sucker 0.10; ova, 0.066 by 0.040. Two hundred and thirty-four, collected January 22, 1915; 12 fishes examined. Thirty-seven (U.S.N.M. No. 8284), collected February 16, 1915, from one fish.

Two, collected July 15, 1926; 4 fishes examined. Distomes slightly macerated. These distomes from the cod are slender, neck densely spinose, spines less dense on anterior part of the body, sparse toward the middle of the length, disappearing near the posterior end. Neck when flattened slightly spatulate, broader and thinner than the subcylindrical body. The neck is supplied with numerous pyriform glands. Oral sucker a little larger than the ventral sucker, its opening directed forward; pharynx small, longer than broad; prepharynx, in uncontracted specimens, longer than the pharynx; esophagus much longer than the pharynx, depending on the degree of contraction, in some cases from twice to more than four times the length of the pharynx. Intestinal rami begin from about the middle to the posterior third of the neck and extend to the posterior end of the body. Genital aperture in front of ventral sucker; cirrus bulb oval-elliptical, about twice as long as broad, anterior and dorsal to ventral sucker; cirrus spinose; seminal vesicle moderately voluminous, extending back of ventral sucker; testes two, one following the other, the interval between them approximately equal to the length of a testis, and filled with follicles of the vitellaria. Ovary subglobular, a short distance

in front of the first testis, and at about the middle of the post-acetabular region; seminal receptacle at posterior border of ovary; vitellaria diffuse, extending from posterior end to the seminal vesicle, in most cases interrupted at the levels of the testes and ovary. The uterus lies between the ovary and the ventral sucker, passing ventral to the seminal vesicle, then to the left of the cirrus bulb to the genital pore.

TABLE 22.—Measurements of four specimens of *Lepidapedon elongatum*, Nos. 1 and 2 in glycerin, Nos. 3 and 4 in balsam

| Measurement | 1 | 2 | 3 | 4 |
|---------------------------------|------------|------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 4.62 | 4.62 | 3.78 | 2.03 |
| Breadth of neck..... | .40 | .42 | .27 | .27 |
| Breadth of body..... | .35 | .38 | .25 | .29 |
| Diameter of oral sucker..... | .14 | .14 | .11 | .10 |
| Pharynx, length..... | .08 | .11 | .08 | .08 |
| Pharynx, breadth..... | .08 | .08 | .04 | .04 |
| Diameter of ventral sucker..... | .11 | .13 | .10 | .10 |
| Length of prepharynx..... | .20 | .21 | .17 | .13 |
| Ova..... | .07 by .04 | .07 by .04 | .06 by .03 | .07 by .04 |

From pollack: One (U.S.N.M. No. 8285) collected May 28, 1913. Length, in formalin, 2.03 mm.; breadth, 0.35 mm. Measurements in balsam: Length, 1.68 mm.; breadth, 0.35 mm.; diameter of oral sucker, 0.08 mm.; pharynx, length, 0.08 mm., breadth, 0.04 mm., ventral sucker, length, 0.07 mm., breadth, 0.08 mm.; length of esophagus, 0.19 mm.; ova, 0.06 by 0.03 mm. Slender, of nearly same breadth throughout, neck slightly attenuate, and posterior end slightly tapering to blunt point. Details of anatomy in close agreement with distomes from cod.

From summer flounder: *Distoma* sp., Bull. U. S. Fish Comm. for 1899, pp. 482, 483, figs. 345, 352, 1901.

From codling: One (U.S.N.M. No. 8286), collected October 28, 1914; 10 fishes examined. Length, in formalin, 5.25 mm., breadth, 0.67 mm.; diameter of oral sucker, 0.18 mm., of ventral sucker, 0.18 mm.

One, collected August 20, 1915. Measurements in balsam: Length, 2.66 mm.; breadth, 0.49 mm.; diameter of oral sucker, 0.09 mm., of ventral sucker, 0.09 mm.; pharynx, length, 0.07 mm., breadth, 0.054 mm.; length of prepharynx, 0.12 mm., of esophagus, 0.10 mm.; ova, 0.060 by 0.045 mm.

The neck in each of these distomes from the hake was slightly tapering anteriorly, there being no indication of the spatulate condition noted in distomes from the cod.

From goggler: One, collected August 29, 1913. Small, spinose, immature. Measurements, life: Length, 0.7 mm.; breadth, 0.16 mm.

In balsam, length, 0.54 mm.; breadth, 0.12 mm.; diameter of oral sucker, 0.03 mm., of pharynx, 0.02 mm., of ventral sucker, 0.03 mm.; length of prepharynx, 0.03 mm., of esophagus, 0.04 mm. Rudiments of genitalia agree in relative positions with this species.

LEPIDAPEDON RACHION (Cobbold)

PLATE 5, FIGURE 46

Lepidapedon rachion (Cobbold), STAFFORD, Zool. Anz., vol. 27, p. 487, 1904.—

MANTER, Illinois Biol. Mon., vol. 10, No. 2, pp. 84, 85, figs. 45, 46.

Lepodora rachiaea (Cobbold), ODHNER, Die Trematoden des arktischen Gebietes, Fauna Arctica, vol. 4, p. 332, pl. 2, figs. 12–15, 1905.

Distomes referred to this species were found in the sea bass, cod, haddock, and silversides. Differences in details of structure, which are many, may generally be accounted for by differing states of contraction, and differences in age. In general the outline is long oval, usually tapering more anteriorly than posteriorly, the neck and anterior part of the body bearing short, scalelike spines, which are evanescent; ventral sucker smaller than oral; pharynx relatively large; prepharynx as long, or longer, than pharynx; esophagus very short, often indistinguishable; genital pore in front of ventral sucker, on median line; cirrus-pouch in front of, and dorsal to ventral sucker; the seminal vesicle, often large, and extending back of the ventral sucker; testes two, one following the other; ovary in front of first testis and near it; testes and ovary relatively small and rounded; vitellaria diffuse, extending from the posterior end to the level of the ventral sucker. Other details, including measurements, given under the several hosts.

Hosts.—Black sea bass (*Centropristes striatus*), common codfish (*Gadus morrhua*), haddock (*Melanogrammus aeglefinus*), silversides (*Menidia notata*).

Record of collections.—One, from black sea bass, collected July 9, 1904. Measurements, life: Length, 3.23 mm.; breadth, anterior 0.37, at level of ventral sucker, 0.67 mm., near posterior end, 0.22 mm.; diameter of oral sucker, 0.35 mm., of pharynx, 0.26 mm., of ventral sucker, 0.24 mm.; ova, 0.05 by 0.04 mm. Measurements in balsam: Length, 2.1 mm.; maximum breadth, 0.4 mm.; diameter of oral sucker, 0.21 mm.; pharynx, length, 0.14 mm., breadth, 0.15 mm.; diameter of ventral sucker, 0.15 mm.; length of prepharynx, 0.21 mm., of esophagus, 0.03 mm.; ova, 0.054 by 0.030 mm. In this distome from the sea bass the vitellaria extended forward about to the level of the anterior border of the ventral sucker and the ovary was a little more to the left than to the right of the median line.

From common codfish. See *Distomum rachion* Cobbold, Proc. U. S. Nat. Mus., vol. 20, pp. 538, 539, 1898.

From haddock: One (U.S.N.M. No. 8287), collected October 31, 1895, Vinal N. Edwards collection. Measurements in formalin: Length, 3.43 mm.; breadth, 0.5 mm.; diameter of oral sucker, 0.42 mm., of ventral sucker, 0.3 mm.; pharynx, length, 0.3 mm., breadth, 0.27 mm.; ova, 0.07 by 0.04 mm.

Three, collected September 3, 1904.

Six, collected October 21, 1904. Length of largest, in formalin, 3.25 mm., breadth, 1 mm.; thickish, appressed, armed with low, flat, rounded spines. Measurements of one in balsam: Length, 1.6 mm.; breadth, 0.63 mm.; oral sucker, length, 0.21 mm., breadth, 0.22 mm.; pharynx, length, 0.18 mm., breadth, 0.15 mm.; ventral sucker, length, 0.15 mm., breadth, 0.17 mm.; ova, 0.06 by 0.03 mm.

The vitellaria in these distomes from the haddock do not extend as far forward as the ventral sucker, and the ovary in some of them is rather more to the right than to the left of the median line.

One, collected August 12, 1909. This is the only distome found in 16 haddock taken on Crab Ledge, off Nantucket. Length, life, 4 mm. Measurements in balsam: Length, 3.5 mm.; breadth, 0.64 mm.; diameter of oral sucker, 0.22 mm., of pharynx, 0.18 mm., of ventral sucker, 0.17 mm.; ova, 0.06 by 0.04 mm. Cirrus pouch elliptical, length, 0.18 mm., breadth, 0.14 mm.; seminal vesicle, relatively large, at posterior border of ventral sucker dorsal to the uterus (fig. 46).

From silversides: A few cysts, collected August 29, 1908, surrounded by black pigment on the skin of a silversides, contained immature distomes which agree with this species. Measurements, life: Length, 0.66 mm.; breadth, 0.29 mm.; diameter of oral sucker, 0.12 mm., of ventral sucker, 0.08 mm.; pharynx, length, 0.08 mm., breadth, 0.05 mm. Rudiments of the seminal vesicle, ovary, shell-gland, testes, and vitellaria were present, the latter extend forward to the level of the ventral sucker. The prepharynx was as long as the pharynx, and the intestinal rami extended to the posterior end.

Genus HOMALOMETRON Stafford, 1904

HOMALOMETRON PALLIDUM Stafford

PLATE 7, FIGURES 65-67

Distomum sp., LINTON, Bull. U. S. Fish Comm. for 1899, p. 442, fig. 354, 1901.

Homalometron pallidum STAFFORD, Zool. Anz., vol. 27, p. 487, 1904.—MANTER, Illinois Biol. Mon., vol. 10, No. 2, pp. 212, 213, figs. 54-56, 1928.

Distomes from various species of Woods Hole fishes while differing more or less among themselves, agree in so many essential char-

acters that it is not advisable to recognize their differences as of specific value.

Body more or less linear, although the proportions vary greatly with different stages of contraction, neck more or less tapering. Neck and anterior portion of body covered with short, blunt spines, becoming sparse posteriorly, more or less evanescent; oral and ventral suckers not differing much in size; pharynx much smaller than oral sucker, usually a little longer than broad; prepharynx and esophagus both present, their relative lengths variable, depending on contraction conditions; intestines extend nearly to posterior end of body, often hidden by the vitellaria; genital pore in front of ventral sucker, median; cirrus pouch lacking; ejaculatory duct and seminal vesicle dorsal to the ventral sucker, usually to the right of the median line, the seminal vesicle extending back of the ventral sucker as far as the ovary, the anterior border of which it often overlaps. The two testes are situated about midway between the ventral sucker and the posterior end, in many cases more or less lobed; ovary in front of first testis to the right of the median line, not lobed; shell gland and yolk reservoir between the ovary and first testis; seminal receptacle in front, and dorsal to the ovary on the right side of the seminal vesicle; vitellaria diffuse, from posterior end to, or nearly to, the level of the posterior margin of the ventral sucker; ova few, in front of testes, 0.09 or 0.1 mm. in longer, by 0.07 mm. or more in shorter diameter.

Further details given in record of collections.

Hosts.—Mademoiselle (*Bairdiella chrysura*), common killifish (*Fundulus heteroclitus*), spot (*Leiostomus xanthurus*), kingfish (*Menticirrhus saxatilis*), white perch (*Morone americana*), winter flounder (*Pseudopleuronectes americanus*), tautog (*Tautoga onitis*).

Record of collections.—Three (U.S.N.M. No. 8288), from made-moiselle, collected September 10, 1928; 4 fishes, 62 to 68 mm. in length, examined, seined at Wareham. Measurements, balsam: Length, 2.87 mm.; breadth, 0.59 mm.; diameter of oral sucker, 0.21 mm., of pharynx, 0.11 mm., of ventral sucker, 0.21 mm.; ova, 0.096 by 0.069 mm. These distomes resemble those from *M. saxatilis*, collected on the same date and from the same locality. Spines evanescent; prepharynx a little longer than pharynx, esophagus about same length as pharynx.

From common killifish: Seven (U.S.N.M. No. 8289), collected January 10, 1917, from one fish, eight fishes examined.

From spot: Collected by Vinal N. Edwards on 16 dates in the months of September and October in the years 1912, 1913, and 1914. His record shows a total of 40 distomes from 231 fishes. The largest

number on any date was 6, from 42 fishes on one occasion, from 23 on another. On seven dates but one distome was recorded; on one of these dates 50 fishes were examined.

Five (U.S.N.M. No. 8240), collected September 16, 1912; 10 fishes examined.

TABLE 23.—*Measurements of four specimens of Homalometron pallidum in balsam*

| Measurement | 1 | 2 | 3 | 4 |
|---------------------------------|------------|------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 4.62 | 3.51 | 2.32 | 1.54 |
| Maximum breadth..... | 1.02 | .78 | .56 | .45 |
| Oral sucker, length..... | .35 | .26 | .28 | .18 |
| Oral sucker, breadth..... | .37 | .24 | .28 | .19 |
| Length of prepharynx..... | .28 | .14 | .08 | .07 |
| Pharynx, length..... | .15 | .14 | .11 | .10 |
| Pharynx, breadth..... | .16 | .13 | .11 | .10 |
| Length of esophagus..... | .07 | .07 | .07 | .00 |
| Ventral sucker, length..... | .36 | .28 | .25 | .20 |
| Ventral sucker, breadth..... | .36 | .28 | .25 | .10 |
| Ova (collapsed) 0.096 by 0.051. | | | | |

From kingfish: Three (U.S.N.M. No. 8291), collected September 11, 1907. Measurements, life, compressed: Length, 4.5 mm.; breadth, anterior, 0.36 mm., middle, 0.32 mm., behind testes, 0.78 mm.; oral sucker, length, 0.26 mm., breadth, 0.25 mm.; pharynx, length, 0.14 mm., breadth, 0.08 mm.; ventral sucker, length, 0.26 mm., breadth, 0.26 mm.; ova, 0.10 by 0.06 mm. Prepharynx longer than pharynx; esophagus short. The seminal vesicle at its anterior end dorsal to the posterior edge of the ventral sucker, extending back to ovary; seminal receptacle somewhat elongated, at right side of seminal vesicle, and extending back dorsal to ovary.

Five (U.S.N.M. No. 8292), collected October 24, 1912; two fishes, length, 150 mm., examined.

Eight, collected October 31, 1912; ten fishes, length 125 mm., examined. Length, 1.98 mm.; breadth, 0.5 mm., in formalin. Most of these distomes, mounted in balsam, are strongly contracted. In one the vitellaria were reduced so that the intestines could be seen. They reached to within 0.18 mm. of the posterior end.

Forty (U.S.N.M. No. 8293), collected August 28, 1928; 34 fishes, 81 mm. to 137 mm. in length, examined.

These distomes, in balsam, vary from 1.3 to nearly 5 mm. in length, and are of great variety of shapes and proportions, as shown in the following table:

TABLE 24.—*Measurements of five specimens of Homalometron pallidum in balsam*

| Measurement | 1 | 2 | 3 | 4 | 5 |
|------------------------------|------------|------------|------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 4.48 | 3.15 | 3.08 | 2.68 | 1.79 |
| Length of neck..... | 1.02 | .75 | .77 | .77 | .42 |
| Maximum breadth..... | .98 | 1.14 | .74 | .63 | 1.19 |
| Oral sucker, length..... | .29 | .26 | .24 | .25 | .22 |
| Oral sucker, breadth..... | .29 | .22 | .28 | .25 | .24 |
| Length of prepharynx..... | .21 | .05 | .17 | .14 | .00 |
| Pharynx, length..... | .11 | .08 | .10 | .10 | .05 |
| Pharynx, breadth..... | .12 | .08 | .07 | .11 | .05 |
| Length of esophagus..... | .07 | .04 | .05 | .07 | .00 |
| Ventral sucker, length..... | .30 | .24 | .25 | .19 | .28 |
| Ventral sucker, breadth..... | .28 | .24 | .25 | .15 | .28 |
| Ovary, length..... | .23 | .17 | .14 | .14 | .17 |
| Ovary, breadth..... | .21 | .25 | .17 | .12 | .24 |
| First testis, length..... | .23 | .31 | .33 | .24 | .14 |
| First testis, breadth..... | .22 | .45 | .32 | .24 | .39 |
| Second testis, length..... | .56 | .77 | .39 | .18 | .21 |
| Second testis, breadth..... | .35 | .70 | .35 | .26 | .43 |
| Ova..... | .10 by .09 | .10 by .06 | .10 by .05 | .10 by .07 | .10 by .06 |

From white perch: Five (U.S.N.M. No. 8294), collected April 28, 1914; two fishes examined. Largest, in formalin, length, 4 mm.; breadth, 1.35 mm. Measurements in balsam: Length, 2.94 mm.; breadth, 1.05 mm.; oral sucker, length, 0.35 mm., breadth, 0.39 mm.; pharynx, length, 0.15 mm., breadth, 0.13 mm.; ventral sucker, length, 0.39 mm., breadth, 0.42 mm.; no ova. Seminal vesicle dorsal to right border of ventral sucker, extending back of ventral sucker and overlapping the ovary, seminal receptacle dorsal to posterolateral border of ovary; yolk reservoir between ovary and first testis.

From winter flounder: The distome recorded from this host under the name *D. globiphorum* Rudolphi (Bull. U. S. Fish Comm. for 1899, p. 486, fig. 347, 1901), probably belongs here. Nine (U.S.N.M. No. 8295), collected July 28, 1905; length, 4 mm. One, collected February 10, 1913; 30 fishes examined; length, 3 mm., in formalin. Five, collected October 16, 1914; one fish examined. Sixteen, collected February 16, 1915; four fishes examined.

TABLE 25.—*Record of distomes of Homalometron pallidum from young Pseudopleuronectes americanus*

| Fishes examined | Date collected | Length of fishes | Fishes parasitized | Degree of parasitization | Total distomes | Appendiculate distomes found |
|-----------------|------------------------------------|------------------|--------------------|--------------------------|----------------|------------------------------|
| | | <i>Mm.</i> | | | | |
| 65 | 10 dates, June 30 to Sept. 10..... | 100 to 190..... | 23 | 1-40 | 173 | None. |
| 264 | 28 dates, June 27 to Sept. 18..... | 21 to 98..... | 187 | 1-484 | 5,516 | On 4 dates. |
| 14 | July 27, 1915..... | ..... | 10 | 3-317 | 1,195 | |
| 12 | June 27, 1916..... | ..... | ..... | ..... | 1 | |
| 14 | July 28..... | ..... | 12 | 2-75 | 268 | |
| 12 | Aug. 1..... | ..... | 2 | 3-5 | 8 | |

1 Seined in Katama Bay.

2 Seined in Great Harbor.

3 Seined at Monument Beach.

While the food of young winter flatfish was being studied in the summers of 1915 and 1916, a record was kept of the distomes found. With few exceptions these distomes were referred to the species *Homalometron pallidum* (U.S.N.M. No. 8296) and *Hemiurus appendiculatus*. The appendiculatus, for the most part, came from the stomachs, the others from the intestines of their hosts.

Twenty-three, collected August 9, 1923; eight fishes examined.

Twelve, collected July 29, 1929. Smallest, length, 1.60 mm.; breadth, 0.53 mm.; largest, length, 3.20 mm., breadth, 0.77 mm.; ova, 0.096 by 0.042 mm.

These distomes from the winter flatfish, representing as they do a great variety of forms, agree in all essential particulars with this species as defined in the foregoing descriptions. Such differences as exist may be accounted for by differences in age and in contraction conditions. Thus, in distomes of the same lot there are some in which the seminal vesicle and seminal receptacle are clearly defined, some in which the seminal vesicle cannot be made out, some in which the seminal receptacle cannot be seen, and some in which neither of the seminal vessels can be distinguished. Evidently conditions varying from plethora to emptiness account for the apparent variation in these organs. In like manner differences in states of contraction, especially of the neck, explain many apparently radical differences in relative proportions. Differences harder to reconcile are seen in a tendency of the testes to be more or less lobed. Also, the ventral sucker tends in some to be a little larger than the oral sucker. (U.S.N.M. No. 8297.)

TABLE 26.—Measurements of six specimens of *Homalometron pallidum* in balsam

| Measurement | 1 | 2 | 3 | 4 | 5 | 6 |
|------------------------------|------------|------------|------------|------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 3.74 | 3.39 | 3.57 | 2.31 | 3.50 | 3.75 |
| Maximum breadth..... | .66 | .48 | .49 | .95 | .42 | .52 |
| Oral sucker, length..... | .28 | .25 | .28 | .24 | .25 | .32 |
| Oral sucker, breadth..... | .34 | .19 | .24 | .24 | .20 | .22 |
| Length of prepharynx..... | .07 | .25 | .25 | .08 | .21 | .28 |
| Pharynx, length..... | .19 | .14 | .17 | .17 | .14 | .21 |
| Pharynx, breadth..... | .15 | .11 | .14 | .11 | .10 | .14 |
| Length of esophagus..... | .07 | .14 | .08 | .07 | .10 | .16 |
| Ventral sucker, length..... | .31 | .25 | .36 | .28 | .30 | .36 |
| Ventral sucker, breadth..... | .31 | .14 | .25 | .34 | .21 | .22 |
| Ova, 0.09 by 0.06. | | | | | | |

From tautog: One, collected April 26, 1915. Measurements in balsam: Length, 0.81 mm.; breadth, 0.35 mm.; diameter of oral sucker, 0.15 mm., of pharynx, 0.08 mm., of ventral sucker, 0.15 mm.

Subfamily STEPHANOPHIALINAE Nicoll, 1909

Genus CREPIDOSTOMUM Braun, 1900

CREPIDOSTOMUM FARONIS (O. F. Müller)

PLATE 22, FIGURE 280

Crepidostomum laureatum (Zeder, 1800), BRAUN, 1900, STILES and HASSALL, U. S. Hyg. Lab. Bull. 37, p. 140, 1908.

Crepidostomum faronis (O. F. Müller), LÜHE, in Brauer's Süßwasserfauna Deutschlands, vol. 17, Trematodes, p. 63, fig. 54, 1909.

Body smooth, tapering slightly to each end; six short, blunt papillae around oral sucker, four dorsal and two ventral; ventral sucker larger than oral; prepharynx very short; pharynx much smaller than oral sucker; esophagus about as long as pharynx; intestinal rami extend nearly to posterior end. Genital pore on median line, in front of working of intestine, near posterior end of pharynx; cirrus smooth, cirrus pouch extends back of ventral sucker along its left border and encloses the seminal vesicle at its posterior end. Testes about middle of postacetabular region, one following the other, outlines more or less irregular. Ovary subglobular, a short distance back of ventral sucker, to left of median line; shell gland on posteromedian border of ovary. A yolk reservoir was noted in one specimen between the left anterior border of the first testis and the ovary; vitellaria diffuse, with coarse lobules filling the post-testicular space and extending forward to the level of the posterior end of the pharynx. Uterus between first testis and ventral sucker. The metraterm lies on the dorsal side of the ventral sucker, to the right of the cirrus-pouch. Ova not numerous, average in balsam 0.08 by 0.04 mm. The number in three specimens in balsam was 32, 42, and 90, more or less, respectively.

Host.—Brook trout (*Salvelinus fontinalis*).

Record of collections.—About 25 trout were examined for internal parasites on July 4, 1905, at Alder Lake in the Catskills, New York; 2 distomes found, 1 from each of two fish. (U.S.N.M. No. 8298.) Measurements of one, life: Length, 2.45 mm., breadth, 1.26 mm.; diameter of oral sucker, 0.32 mm., of pharynx, 0.23 mm., of ventral sucker, 0.43 mm.; ova, 0.06 by 0.045 mm. When compressed the greatest breadth was at about the anterior third at the level of the ventral sucker, thence tapering to the bluntly rounded anterior end, and more gradually, to the posterior end. A slide contains three specimens collected June 26, 1911, not in good condition. My notes made during my second visit to Alder Lake are missing.

TABLE 26.—*Measurements of three specimens of Crepidostomum faronis in balsam*

| Measurement | 1 ¹ | 2 ¹ | 3 ¹ |
|---|----------------|----------------|----------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 2.97 | 2.55 | 2.53 |
| Breadth, level of oral sucker..... | .46 | .42 | .24 |
| Breadth, level of ventral sucker..... | 1.15 | 1.08 | .66 |
| Breadth, level of testes..... | 1.06 | .87 | .62 |
| Anterior edge of ventral sucker to anterior end..... | .77 | .62 | .63 |
| Posterior edge of ventral sucker to ovary..... | .06 | .13 | .07 |
| Posterior edge of ventral sucker to first testis..... | .46 | .52 | .56 |
| Posterior edge of second testis to posterior end..... | .84 | .70 | .56 |
| Oral sucker, length..... | .29 | .24 | .17 |
| Oral sucker, breadth..... | .35 | .32 | .24 |
| Pharynx, length..... | .21 | .15 | .11 |
| Ventral sucker, length..... | .43 | .38 | .28 |
| Ventral sucker, breadth..... | .49 | .39 | .31 |
| Ovary, length..... | .25 | .21 | .24 |
| Ovary, breadth..... | .21 | .21 | .20 |
| First testis, length..... | .22 | .18 | .22 |
| First testis, breadth..... | .25 | .35 | .28 |
| Second testis, length..... | .24 | .21 | .28 |
| Second testis, breadth..... | .28 | .28 | .29 |

¹ Ventral view.¹ Lateral view.

Family DIPLOPROCTODAEIDAE Ozaki, 1928

Genus BIANIUM Stunkard, 1930

BIANIUM PLICITUM (Linton)

PLATE 6, FIGURE 57; PLATE 7, FIGURES 58-64

Distomum sp. LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 537, 538, figs. 1, 2, 1898; Bull. U. S. Fish Comm. for 1899, vol. 19, p. 464, 1901; Bull. Bur. U. S. Fish Comm. for 1904, vol. 24, pp. 359, 385, 402, fig. 165, 1905.

Petlostomum plicitum LINTON, Proc. U. S. Nat. Mus., vol. 73, art. 1, p. 5, fig. 7, 1928.

Bianium concavum STUNKARD, Anat. Rec., vol. 47, p. 362, 1930.

Bianium plicitum (LINTON), STUNKARD, Zeitschr. für Parasitenk., vol. 3, pp. 715-719, figs. 3-7, 1931.

Body oblong, anterior end, when flattened, with margins of neck slightly expanded and more or less undulate; neck and anterior part of body densely covered with minute spines; oral sucker a little larger than ventral sucker, its opening ventral, its anterior border a short distance back of the anterior end of the body; pharynx variable, usually broader than long, its anterior border in some cases scalloped; prepharynx and esophagus short; intestinal rami extend to posterior end of body, where they open by distinct ani at the postero-lateral margins.¹³ Genital pore at left anterior edge of ventral

¹³ Dr. Stunkard has called my attention to the presence of two distinct anal openings in this distome. I had overlooked this unique character, possibly because the specimens examined most closely had the intestinal rami hidden by the vitellaria, but probably because the attention that would be required to lead to such an unlooked-for characteristic was not given.

sucker; cirrus smooth; cirrus bulb near left dorsal margin of ventral sucker, and extending back of ventral sucker, enclosing the prostatic cells and a seminal vesicle at its posterior end. There is a second seminal vesicle connected with the base of the cirrus bulb by a short vas deferens. The second seminal vesicle is, in some cases, relatively large, in others it is small and obscured by the ova. Testes two, situated toward the posterior end, one following the other closely, and usually slightly diagonally placed, in some cases slightly lobed. Ovary profoundly lobed, as many as twenty lobes were counted in a few instances, situated ventrally at the anterior border of the first testis. Seminal receptacle elongated, at the left side of the ovary and first testis. Laurer's canal enters the seminal receptacle at its posterior end. The uterus lies between the ovary and the ventral sucker. The thick-walled metraterm lies on the left side of the cirrus pouch; ova from about 0.06 by 0.04 mm. to 0.07 by 0.05 mm. in balsam, the shells rather thin and usually collapsed in balsam mounts; vitellaria diffuse, from posterior end to ventral sucker, their breadth on the margins often from one-fourth to one-third the breadth of the body; yolk reservoir at posterior border of ovary. The excretory vessel at the posterior end of the body extends forward to about the anterior end of the first testis. Measurements in balsam: Length, 3.12 mm.; breadth, 1.24 mm.; oral sucker, length, 0.27 mm., breadth, 0.28 mm.; pharynx, length, 0.18 mm., breadth, 0.25 mm.; diameter of ventral sucker, 0.25 mm.; ova, 0.07 by 0.04 mm. An average of seven distomes, maximum length 3.12 mm., minimum 1.40 mm., gave the following results: Oral sucker, length, 0.19 mm., breadth, 0.22 mm.; pharynx, length, 0.14 mm., breadth, 0.18 mm.; ventral sucker, length, 0.19 mm., breadth, 0.21 mm.

Hosts.—Smooth puffer (*Lagocephalus laevigatus*), tomcod (*Microgadus tomcod*), puffer (*Sphoeroides maculatus*).

Record of collections.—From smooth puffer: Proc. U. S. Nat. Mus., vol. 20, pp. 537, 538, pl. 53, figs. 1, 2, 1898; Bull. U. S. Fish Comm. for 1899, p. 464, 1901. One, collected July 17, 1906.

From tomcod: One (U.S.N.M. No. 8299), collected June 8, 1914. Measurements in balsam: Length, 2.38 mm.; breadth, 0.98 mm.; diameter of oral sucker, 0.21 mm., of pharynx, 0.17 mm., of ventral sucker, 0.19 mm.; ova, 0.066 by 0.033 mm. Pharynx with sinuous anterior border.

From puffer: Bull. U. S. Fish Comm. for 1899, p. 464, 1901. Fifty-two (U.S.N.M. No. 8300), collected July 9, 1904, from intestines of two fishes. Nine, collected August 17, 1904. Twenty-eight, collected May 31, 1905. Most of these came from a piece of intestine of the host 40 mm. in length, preserved in formalin. Twelve, collected by Dr. Irving I. Field, July 8, 1905, from intestine of the host; white, squarish distomes. Thirty-four, collected August 6, 1906, from two

fishes; small, greenish or yellowish white, usually rather squarish in outline; that is, ends truncate and sides linear; lateral margins of neck expanded, in some cases folded under ventrally.

Two, collected August 9, 1906, from intestine of one fish. One, collected August 10, 1906, from intestine of one fish. Four, collected August 16, 1906, from intestine of one fish. Three, collected August 17, 1906, from intestine of one fish. Four, collected August 18, 1906, from intestine of one fish. Five, collected August 23, 1906, from intestine of one fish. One hundred and fourteen, collected August 1, 1907, from the intestines of two fishes. Thirty-four, collected August 2, from one fish. Many, collected August 10, from one fish. One hundred and fifty-one, collected June 28, 1910, from intestines of four fishes.

One hundred and ten, collected June 30, 1910, from two fishes; yellowish white, some rose color; shape irregular, many almost rectangular, others roughly triangular, tapering anteriorly and retuse at posterior end, a few arcuate; flattened under the cover-glass they become oblong with bluntly rounded anterior, and more or less truncated posterior ends. Measurements of largest, life: Length, 3.95 mm.; breadth, 1.57 mm.; diameter of oral sucker, 0.39 mm., of pharynx, 0.35 mm., of ventral sucker, 0.39 mm.

Ninety-three, collected July 5, 1910, from nine fishes. Twenty, collected July 27, from one fish; one of these, an adult with ova, from a cyst on the intestine of the host. Twenty-eight, collected July 5, 1910, from each of two fishes, number not recorded. One, collected September 6, 1910; two fishes examined. Fifty-two, collected June 1, 1914, from 15 fishes. Forty-five, collected June 8, 1914, from one fish. One hundred and thirty-nine, collected June 9, 1914, from one fish, six fish examined. Eighty-eight, collected June 8, 1915, from 16 fishes. One, collected July 2, 1915.

Family BUNODERIDAE Nicoll

Genus BUNODERA Railliet, 1896

BUNODERA NODULOSA (Froelich)

PLATE 22, FIGURES 290, 291

On April 23, 1914, Mr. Edwards examined 12 yellow perch (*Perca flavescens*) and found two distomes that appear to belong to this species (U.S.N.M. No. 8301).

Note on formalin material: Globular, or nearly so; dorsal region and neck white; ventral region swollen with ova, in which the eye spots of the contained miracidia can be seen; ventral sucker white with circular opening, slightly prominent, like an inverted saucer. The mouth is surrounded by six short, blunt papillae. Length,

2.25 mm.; breadth, 1.5 mm.; thickness, 1.6 mm.; ova, 0.077 by 0.042 mm.

Measurements in balsam: Length, 1.12 mm.; breadth, 0.84 mm.; diameter of oral sucker, 0.42 mm., of ventral sucker, 0.42 mm.; ova, 0.045 by 0.030 mm. to 0.069 by 0.045 mm.

Details of the anatomy are hidden by the mass of ova. This species has been found in Canada by Stafford (Zool. Anz., vol. 27, pp. 489, 490, 1904). So far as the anatomy can be made out these distomes are in agreement with Stafford's material, although they are somewhat smaller. The measurements of the ova are not given by Stafford. Looss (Zool. Jahrb., vol. 12, p. 598, 1899) gives the size of the ova 0.10 by 0.05 mm. He notes also the occurrence of miracidia with eye spots in the ova.

Family AZYGIIDAE Odhner, 1911

Genus AZYGIA Looss, 1899

AZYGIA LONGA (Leidy)

PLATE 22, FIGURES 292-297

Azygia longa (Leidy), MANTER, Illinois Biol. Mon., vol. 10, no. 2, pp. 63-72, figs. 19, 20, 30, 1926 (synonymy, p. 63).

Upon reviewing the distomes in my collection I find examples from three species of fishes, two fresh water and one marine, which, according to Manter's synopsis (loc. cit., p. 78) are to be referred to the species *Azygia longa* (Leidy). A brief description of this material is given as supplementary to Manter's careful diagnosis of this widely distributed and variable species.

Hosts.—Eastern pickerel (*Esox niger*), small-mouthed black bass (*Micropterus dolomieu*), cutlassfish (*Trichiurus lepturus*).

Record of collections.—From eastern pickerel, 12 distomes (U.S.N.M. No. 8302) attached to walls of stomach, collected May 5, 1898, by F. L. Harvey, Orono, Maine. Neck and anterior part of body nearly cylindrical; posterior part of body may be slightly compressed, smooth, but with fine transverse rugae; oral sucker larger than ventral; pharynx short, cylindrical; esophagus very short; intestinal rami reach to posterior end. Genital pore at anterior border of ventral sucker, on median line; cirrus-pouch, enclosing the prostate gland and coiled vas deferens, at anterior dorsal border of ventral sucker; cirrus and metraterm opening into a common atrium. Testes small, near together, one following the other, nearer to posterior end than to ventral sucker. The ovary is in front of the first testis, from which it was separated, from 0.08 to 0.15 mm. The shell gland and yolk reservoir are situated on the anterior and anterodorsal border of the ovary. Laurer's canal was noted, but no seminal receptacle

was seen. The uterus occupies the space between the shell gland and the ventral sucker. The vitelline glands are marginal and extend from a point a short distance back of the ventral sucker to a point about halfway between the second testis and the posterior end. Measurements of one of larger specimens in balsam: Length, 6.50 mm.; maximum diameter, 0.75 mm.; oral sucker, length, 0.67 mm., breadth, 0.60 mm.; pharynx, length, 0.28 mm., breadth, 0.21 mm.; ventral sucker, length, 0.36 mm., vertical diameter, 0.24 mm. An average of 36 of the larger ova, in a series of sections, was 0.042 by 0.025 mm.; the largest observed measured 0.054 by 0.033 mm.

From small-mouthed black bass: Collected by J. L. Robertson at Culver Lake, N. J., one specimen in June, 1905, seven specimens on November 15, 1907 (U.S.N.M. No. 8303). These distomes from the black bass differ from those found in the pickerel in the relative positions of testes and ovary. In the distomes from the pickerel the testes are separated from each other by a space equal to or greater than the diameter of a testis, and the ovary is separated from the first testis by a space about equal to its diameter, while in the distomes from the bass the testes and ovary are very close together, in most cases being actually in contact with each other. In four of the six mounted specimens the ovary lies directly in front of the first testis, in the others it lies beside the first testis, being crowded back by the uterus. In an immature specimen 2.17 mm. in length the ovary is separated from the first testis by a space nearly equal to its diameter. In another, immature, specimen, 2.10 mm. in length, the testes are in contact with each other, and the ovary is in contact with the anterior edge of the first testis. An average of 15 of the larger ova, in balsam mounts, was 0.056 by 0.029 mm.; the largest, 0.057 by 0.030 mm.; the smallest, 0.048 by 0.027.

From cutlassfish: This record is based on a series of sagittal sections of one distome, and a series of frontal sections of the anterior end of another. These sections occur in a lot which was prepared of the distome *Sterrhurus monticellii* from the cutlassfish. These sections are on a slide along with sections of a specimen of *S. monticellii*. Careful search was made for other examples of *Azygia* among the large number of *S. monticellii* in the collection but none were found.

The agreement between this material from the cutlassfish and that from the bass and pickerel is close. The testes and ovary are in contact with each other, as in the bass. The vitellaria are lateral, between the lateral margin and the intestinal rami, distributed more ventrally than dorsally, and extend from about 0.15 mm. back of the ventral sucker nearly to the posterior end. Ova numerous, maximum about 0.06 by 0.03 mm. Ova in the anterior folds of the uterus contain miracidia.

The following measurements are given for purposes of comparison with measurements tabulated in Manter's monograph:

TABLE 27.—Measurements of nine specimens of *Azygia longa*

| Measurement | 1 ¹ | 2 ¹ | 3 ¹ | 4 ¹ | 5 ¹ | 6 ¹ | 7 ¹ | 8 ¹ | 9 ¹ |
|--|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| | Mm. | Mm. | Mm. | Mm. | Mm. | Mm. | Mm. | Mm. | Mm. |
| Length..... | 6.65 | 5.46 | 7.00 | 5.74 | 5.39 | 4.90 | 2.10 | 4.00 | 3.00 |
| Breadth..... | .70 | .63 | .91 | .70 | .60 | .59 | .42 | .43 | .63 |
| Oral sucker, diameter..... | .56 | .53 | | | | | | | |
| Oral sucker, length..... | | | .49 | .60 | .35 | .35 | .28 | .42 | .56 |
| Oral sucker, breadth..... | | | .63 | .46 | .52 | .49 | .31 | .42 | .52 |
| Pharynx, length..... | | | .21 | .28 | .21 | .21 | .14 | .21 | .25 |
| Pharynx, breadth..... | | | .21 | .25 | .15 | .17 | .11 | .16 | .21 |
| Ventral sucker, diameter..... | .46 | .39 | | | | | | | |
| Ventral sucker, length..... | | | .43 | .39 | .32 | .28 | .25 | .32 | .45 |
| Ventral sucker, breadth..... | | | .45 | .45 | .39 | .38 | .27 | .25 | .41 |
| Posterior edge of ventral sucker to middle of ovary..... | 2.33 | 2.10 | 2.24 | 2.03 | 2.06 | 2.10 | .50 | .47 | ----- |
| Posterior edge of ventral sucker to anterior end..... | 1.71 | 1.54 | 1.47 | 1.96 | 1.72 | 1.12 | .98 | 1.51 | 1.92 |
| Posterior edge of ventral sucker to anterior vitellaria..... | .42 | .28 | .24 | .35 | .35 | .35 | ----- | ±.14 | ±.15 |
| Posterior edge of testes to posterior end..... | 1.71 | 1.33 | 1.89 | 1.33 | 1.12 | 1.15 | .52 | .80 | ----- |
| Vitellaria on left beyond testes..... | .98 | 1.26 | .78 | ±.90 | ±.34 | .90 | ----- | ±.28 | ----- |
| Vitellaria on right beyond testes..... | 1.02 | 1.23 | 1.05 | ±.42 | ±.56 | .60 | ----- | ±.21 | ----- |

¹ Balsam mounts from *Esox niger*.

² Sagittal sections.

³ Balsam mounts from *Micropterus dolomieu*.

⁴ Frontal sections from *Trichiurus lepturus*.

Genus OTODISTOMUM Stafford, 1904

OTODISTOMUM CESTOIDES (van Beneden)

Distomum cestoides VAN BENEDEN, Mem. Acad. Roy. Belgique, vol. 38, p. 17, pl. 4, fig. 9, 1870.

Distomum veliporum Creplin (?), LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 521, 522, 1898.

Otodistomum veliporum Creplin, STAFFORD, Zool. Anz., vol. 27, pp. 482, 483, 1904. *Xenodistomum melanocystis*, *ibid.*, p. 483.

Otodistomum cestoides (van Beneden), MANTER, Illinois Biol. Mon., vol. 10, No. 2, pp. 140-186, figs. 1-6, 8-10, 23-26, 28, 1926.

An intensive study of this distome has been made by Manter, *loc. cit.*

Hosts.—Clear ray (*Raja diaphanes*), barndoor skate (*Raja laevis*), filefish (*Ceratacanthus schoepfi*), fishingfrog (*Lophius piscatorius*), rudderfish (*Palinurichthys perciformis*).

Record of collections.—From clear ray: One, immature (U.S.N.M. No. 8304), collected May 18, 1914. Measurements in formalin: Length, 7.5 mm.; breadth, 1.5 mm.; thickness, 1 mm. Measurements in balsam: Length, 5.5 mm.; maximum breadth, at level of ventral sucker, 1.33 mm., breadth midway between ventral sucker and posterior end, 1.29 mm.; oral sucker, length, 0.66 mm., breadth, 0.70 mm.; pharynx, length, 0.38 mm., breadth, 0.21 mm.; ventral sucker, length,

0.97 mm., breadth, 1.04 mm. Ovary, 0.9 mm. back of ventral sucker, length, 0.14 mm., breadth, 0.25 mm.; testes about equal, length, 0.21 mm., breadth, 0.35 mm. The testes and ovary are close together, the group measuring about 0.46 mm. in length and 0.56 mm. in breadth. Aperture of oral sucker, length, 0.14 mm., breadth, 0.22 mm., of ventral sucker, length, 0.35 mm., breadth, 0.24 mm. (U.S.N.M. No. 8304.)

From barndoor skate: One, fragment (U.S.N.M. No. 8305), collected October 28, 1898. One, fragment; length in formalin, 10 mm. Two, collected November 4, 1898; lengths, 24 and 25 mm., respectively; breadth, 3.5 mm., nearly linear; neck reflected dorsally; color in formalin yellowish white to ashy gray, with dark blotches. Two, collected October 19, 1903; length of larger specimen, 54 mm.; of nearly uniform size from ventral sucker to middle of postacetabular region, thence tapering very slightly to posterior end; distance from anterior end to posterior edge of ventral sucker, 9 mm.; neck reflected dorsally, nearly at right angles to body. Fourteen, collected May 13, 1904; longest in formalin, 28 mm. Three, collected October 28, 1911; lengths in formalin, 11, 12, and 15 mm., respectively; breadth, 2 to 2.25 mm. Three, collected October 10, 1912; lengths in formalin, 22, 23, and 27 mm., respectively; maximum breadth, 4.5 mm. Sixteen, collected April 29, 1913; length of one in formalin, 47 mm., breadth, 4.5 mm. Five, collected April 30, 1913, 12 to 20 mm. in length in formalin. Five, collected May 6, 1913; 10 to 16 mm. in formalin. Four, collected May 9, 1913; largest in formalin, length 27 mm., maximum breadth, 4.5 mm., maximum thickness, 3 mm.; smallest, length, 23 mm., maximum breadth, 3 mm., tapering to posterior end; in each the neck was reflected dorsally nearly at right angles to the body.

The ova, as seen in a series of sections, are about 0.078 mm. by 0.051 mm.; thickness of shell, 0.003 mm.

From filefish: Immature trematodes encysted under the serous coat of the liver of the filefish are here recorded. One, collected July 11, 1910, from serous coat of liver near gall bladder of host; length, 13 mm., diameter, 3.5 mm.; nearly linear, moderately compressed, intestines voluminous; in balsam, diameter of oral sucker, 0.60 mm., of pharynx, 0.42 mm., of ventral sucker, 1.18 mm.

One, collected July 13, 1911, under serous coat of liver of host. Measurements in balsam: Length, 2.24 mm., maximum breadth, 0.73 mm.; oral sucker, length, 0.17 mm., breadth, 0.22 mm.; pharynx, length, 0.17 mm., breadth, 0.15 mm.; ventral sucker, length, 0.31 mm., breadth, 0.35 mm.

From fishingfrog: Immature distomes from the stomach wall of the goosefish are here recorded. The rudiment of the cirrus pouch lies at the posterior border of the pharynx. Rudiments of the ovary

and testes are present, the ovary being in front of the testes. The worms when compressed are usually rather slender and of nearly uniform breadth. The ratio of the suckers would point to *O. veliporum* rather than to *O. cestoides*. Since the studies of Manter show that differences in ratio of suckers are of little value, and other workers, as Mühlenschlag and Odhner, rely mainly on the ova to distinguish between species, it seems best to record these immature distomes under the species *O. cestoides*.

Encysted distomes from the goosefish are recorded by Stafford (Zool. Anz., vol. 27, p. 483, 1904) and referred by him to a new genus and species, *Xenodistomum melanocystis*. Of these encysted distomes he says: "Resembles preceding species (*Otodistomum veliporum* Creplin) but is immature with rudiments of genital organs and ducts."

Five, collected November 11, 1904.

Four, collected July 31, 1905, in cysts on viscera of host. Measurements, life: Length, 4 mm.; breadth, 1.5 mm.; oral sucker, length, 0.35 mm., breadth, 0.49 mm.; pharynx, length, 0.30 mm., breadth, 0.20 mm.; ventral sucker, length, 0.50 mm., breadth, 0.64 mm.; intestines voluminous.

Two, immature, collected July 2, 1910; length, 4 and 5 mm., respectively; breadth, 1 mm. Single excretory vessel from posterior end to a point about halfway between the ventral sucker and the posterior end, there dividing into two lateral branches which were traced to the anterior sucker, but were not seen to unite.

Three, immature, collected July 29, 1910; length, 5 mm. A number of cysts, on and in the stomach wall, most of them containing larvae of the cestode *Rhynchobothrium imparispine*, had been removed from a goosefish. These distomes were found among this material.

Eight, collected May 22, 1911; lengths in formalin, 3 to 6.5 mm. Mr. Edwards' notes do not state where these distomes were found in the goosefish, but they resemble in every particular distomes from cysts on the viscera.

Thirty, immature, collected April 10, 1913; in dark-brown cysts in the stomach wall; cysts oval, 3.5 mm. in diameter, in formalin; brown color due to degenerate tissue; worms plump, from 3 to 5 mm. in length. Measurements in glycerin: Length, 3.12 mm., breadth, 0.87 mm.; breadth of oral sucker, 0.46 mm., of ventral sucker, 0.60 mm.

One, collected July 15, 1914, found by Dr. MacCallum on mesentery of host.

Three (U.S.N.M. No. 8306), collected August 17, 1923, in cysts associated with cestode cysts. Measurements in balsam: Length, 10.5 mm., breadth, 1.65 mm.; oral sucker, length, 0.66 mm., breadth, 0.74 mm.; pharynx, length, 0.28 mm., breadth, 0.25 mm.; diameter of

ventral sucker, 1.09 mm.; cirrus pouch, length, 0.23 mm., breadth, 0.21. mm.

Fourteen, immature, collected July 17, 1924, encysted in submucosa of stomach, surrounded by black, granular pigment; some of them rather active after liberation from cysts. Measurements, life, compressed: Length, 8 mm., breadth, 1.40 mm.; oral sucker, length, 0.67 mm., breadth, 0.53 mm.; pharynx, contracting and expanding, length and breadth at time of measuring, about 0.28 mm.; ventral sucker, length, 0.95 mm., breadth, 0.92 mm.

Two, immature, collected July 7, 1926, from cysts on viscera of host. Seven, collected August 12, 1926, in dark-brown cysts in stomach wall. Measurements in balsam: Length, 0.6 mm.; breadth, 1.61 mm.; oral sucker, length, 0.53 mm., breadth, 0.56 mm.; pharynx, length, 0.28 mm., breadth, 0.21 mm.; ventral sucker, length, 0.95 mm., breadth, 0.91 mm.; cirrus pouch, length, 0.21 mm., breadth, 0.14 mm.

Ratio of suckers, average of six in balsam: Oral sucker, length, 0.503 mm., breadth, 0.588 mm.; ventral sucker, length, 0.875 mm., breadth, 0.871 mm.

From rudderfish: One, immature, collected August 22, 1910; recorded here provisionally.

Note made at time of collecting: Length, 5 mm.; breadth, 1 mm.; thickish, white, smooth, nearly linear, bluntly tapering at each end; dark intestine showing through body wall; black contents of excretory vessel pressed out at excretory pore when cover glass was placed on specimen; genitalia not developed. Measurements in balsam: Length, 4.34 mm., breadth, 0.70 mm.; oral sucker, length, 0.30 mm., breadth, 0.38 mm.; pharynx, length, 0.25 mm., breadth, 0.22 mm.; ventral sucker, length, 0.46 mm., breadth, 0.53 mm. The intestines extend to the posterior end; no trace of genitalia.

Family HEMIURIDAE Looss, 1907

Subfamily SCLERODISTOMINAE Odhner, 1927

Genus HIRUDINELLA Blainville, 1824

HIRUDINELLA FUSCA (Bosc)

PLATE 12, FIGURES 134-144; PLATE 13, FIGURES 145-157

Distomum clavatum Rudolphi, LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 539, 540, pl. 53, figs. 8-11 (from *Xiphias gladius*), 1898; Bull. U. S. Fish Comm. for 1899, p. 445 (from *Thunnus thynnus*), p. 448 (from *Xiphias gladius*), 1901.

Distomum lageniforme LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 524, 525, pl. 47, figs. 1, 2, 1898; Bull. U. S. Fish Comm. for 1899, from *Remora remora*, probably belongs here.

Distomum fuscum Poirier (Bosc), MÜHLSCHLAG, Zool. Jahrb., vol. 37, pp. 217-232, pl. 9, figs. 4-7, 8 figs., 1914.

- Hirudinella clavata* (Menzies), COOPER, Trans. Roy. Soc., Canada, ser. 3, vol. 9, p. 186 (from *Thunnus thynnus*), 1915.
Hirudinella fusca (Poirier, 1885), MANTER, Illinois Biol. Mon., vol. 10, no. 2, pp. 104-107, figs. 75-79 (from *Xiphias gladius*), 1926.

Large distomes belonging to the group represented by *Distomum clavatum* Rudolphi are here considered. The anatomy of these distomes, so far as it is shown by sectioned material from the swordfish, horse mackerel, and cutlassfish, is in general agreement with Manter's excellent description of *H. fusca* (Poirier) from the swordfish.

Externally the distomes from the swordfish exhibit some fairly constant differences from those of the horse mackerel. Thus, in distomes from the swordfish, the neck in alcoholic specimens is usually arched and slender, the body somewhat elongated, increasing in diameter from the ventral sucker toward the posterior end, then tapering quickly and rather coarsely wrinkled (fig. 134). In distomes from the horse mackerel the neck is very short, conical, and reflected dorsally; body, in most cases, cylindrical and crossed by fine wrinkles (fig. 135). Forms more or less intermediate, however, occur among the distomes from each host.

These distomes agree in having the opening of the metraterm behind the genital papilla. The latter is a very muscular structure and in some cases was found to be protruding from the genital pore (fig. 138). A large prostate accompanies the more or less coiled or folded ejaculatory duct, and is followed posteriorly by the seminal vesicle, which is also more or less coiled or folded. The two testes are close to the posterior border of the ventral sucker, close together, and diagonally placed. The ovary is immediately behind the testes, and the shell gland is posterior and ventral to the ovary. The tubular vitellaria and folds of the uterus extend from the ventral sucker about halfway to the posterior end of the body. An interpretation of the genital ducts, associated with the shell gland, as shown in serial sections of a distome from the swordfish, is given in figures 151-153. Laurer's canal approaches the shell gland at its anterodorsal border near the ovary. It enlarges to form a relatively small seminal receptacle, which has the appearance of being divided into five or six compartments. This may represent the more or less coiled portion of the empty canal observed in sections of the distome from the cutlassfish (fig. 150). This observation was made on a series of frontal sections of a distome which had been flattened at the time of fixation. Laurer's canal, in this series of sections, in its course to the dorsal surface, lies near the posterior border of the second testis.

Structures from the subcuticular layer penetrate the cuticle (fig. 155). In one series of sections the cuticle was partly macerated and presented the appearance of being finely papillate, or spinose.

Additional details given in notes under the several hosts.

Hosts.—*Histrio pictus*, rudderfish (*Seriola zonata*), horse mackerel (*Thunnus secundodorsalis*), goggler (*Trachurops crumenophthalma*), cutlassfish (*Trichiurus lepturus*), swordfish (*Xiphias gladius*).

Record of collections.—One, immature (U.S.N.M. No. 8307), collected September 5, 1919, from *Histrio pictus*. This specimen, when first noted, had been cut into three pieces, one cut passing just behind the genital pore, the other a short distance back of the ventral sucker. The body was minutely and transversely wrinkled, and pinkish in color. Aggregate length, before flattening under pressure, about 8 mm.; maximum breadth, 3.5 mm. Measurements in balsam: Length, 13.5 mm.; breadth at oral sucker, 1.54 mm., at ventral sucker, 2.31 mm., maximum breadth, at 3.5 mm. from the posterior end, 3.5 mm.; oral sucker, length, 1.12 mm., breadth, 1.26 mm.; pharynx, length, 0.84 mm., breadth, 0.91 mm.; diameter of ventral sucker, 1.47 mm.; distance between suckers, 2.5 mm. There is no prepharynx. The pharynx tapers from a breadth of 0.9 mm. at its anterior end to about 0.6 mm. at its posterior end. Esophagus short; the voluminous intestines reach to the posterior end. The genital pore is at the right posterior edge of the pharynx. The genital papilla is about 0.7 mm. in length and 0.5 mm. in breadth. The opening of the uterus is not clearly shown, but it appears to be behind the genital papilla. The testes lie near the posterior edge of the ventral sucker. The left testis is subtriangular in outline. Its anterior border is practically contiguous to the posterior edge of the ventral sucker, and its median end on the median line. The right testis is bluntly slipper shaped, its median end contiguous to the posterior median border of the left testis. It is broader than long, and at its lateral end is prolonged anteriorly until it is nearly on a level with the anterior edge of the left testis. The ovary is a short distance behind the testes on the median line. It is much smaller than the testes, subglobular, and is surrounded by a rather thick wall. It is made up of a relatively small number of large, nucleated cells. The rudiment of the shell gland lies at the median and posterior border of the ovary. The uterus, represented by a slender but well-defined tube, lies in a tangled coil on the right side of the ovary, and passes in a wide curve back to within 4 mm. of the posterior end, and forward between the testes, and dorsal to the ventral sucker, toward the genital pore. Certain slender, irregular, threadlike structures in the vicinity of the ovary were noted. They may be rudiments of the vitellaria.

From rudderfish: One, collected September 19, 1912. Measurements in formalin: Length, 12 mm.; breadth, 6 mm.; thickness, 5 mm. Neck and suckers pale, yellowish white; body darker and crossed by transverse rugae (fig. 137).

From horse mackerel: Sixteen (U.S.N.M. No. 8310), collected June 16, 1911. Note made on formalin material: Much variation in size. Measurements, largest: Length of body, 17 mm., of neck, 5 mm.; diameter of body, 6.7 mm. Smallest, length of body 5 mm., of neck, 2.5 mm.; diameter of body, 2.25 mm. In all of these distomes both the body and neck were cylindrical, or nearly so, and the neck was reflected nearly, and in some cases, quite at right angles to the body, in most cases arcuate, but in some straight.

Four, collected June 23, 1911. Measurements in formalin: Largest, length of body, 14 mm., of neck, 3 mm.; diameter of body, 3 mm.

Fourteen (U.S.N.M. No. 8310), collected August 8, 1913, from stomach of host. Pale, translucent pink to brick red, with dark brown intestines showing through the body wall; actively contracting. Smallest, at rest, length about 15 mm., largest, 30 mm. When placed in sea water they exhibited a tendency to adhere to each other by their ventral suckers.

Two, collected July 31, 1914, in stomach of host.

One (U.S.N.M. No. 8308), collected June 29, 1915. This specimen stretched to a length of 40 mm. in sea water, and contracted to 20 mm. when placed in killing fluid. Measurements of a specimen from the horse mackerel mounted in balsam: Length, 14 mm.; breadth, 3.25 mm.; oral sucker, length, 0.92 mm., breadth, 1.00 mm.; breadth of pharynx, 0.56 mm.; ventral sucker, length, 1.82 mm., breadth, 1.78 mm. The testes in this specimen, at the posterior edge of the ventral sucker, are nearly transverse, their median ends touching each other; right testis, length, 0.42 mm., breadth, 0.84 mm.; left testis, length, 0.56 mm., breadth, 0.84 mm.; each testis tapers laterally from its median end. Ovary close to posterior edge of testes, median, its anterior edge convex, posterior edge nearly straight; length, 0.14 mm., breadth, 0.43 mm. The intestines are voluminous, filled with dark-colored food material, and extend to the posterior end of the body. In a series of cross sections (thickness about 0.016 mm.) numbering about 776, the first trace of vitellaria is in the 237th section, and the last in the 538th. The voluminous uterus, filled with enormous numbers of eggs, extends from a point dorsal to the posterior edge of the ventral sucker, at about the 209th section, to about the 510th section. Ova, about 0.036 by 0.024 mm. The genital ducts associated with the shell gland agree closely with the interpretation of sectioned material from the swordfish. In these sections from the horse mackerel, however, the early folds of the uterus contain sperm. The genital papilla, ejaculatory duct, prostate, and metraterm in the distomes from the swordfish and horse mackerel agree. In each the prostate is voluminous (figs. 138, 154).

The genital pore, as shown in sections, is on a level with the pharynx. In a series of cross sections of a distome in which the genital papilla is retracted, the genital pore is ventral to the posterior end of the oral sucker. It is small and occupies only three sections (thickness of sections about 0.016 mm.). The genital atrium is represented by a duct, vertical diameter 0.11 mm., transverse diameter, 0.22 mm., which continues in 47 sections, when it expands at the genital papilla. At the thirteenth section back of the first appearance of the genital papilla, the metraterm, with its thick, muscular wall first appears.

From goggler: One, immature (U.S.N.M. No. 8309), collected August 17, 1913, from cyst on intestine. This distome, when removed from the cyst, was subspherical, translucent, with a faint tinge of pink; intestines dark brown.

Measurements in balsam: Length, 3.4 mm.; maximum breadth, 2.24 mm.; oral sucker, length, 0.46 mm., breadth, 0.49 mm.; diameter of pharynx, 0.28 mm.; ventral sucker, length, 0.74 mm., breadth, 0.88 mm. The body is strongly contracted, and the voluminous intestines, containing dark brown granular material, conceal whatever rudiments of genitalia may be present.

From cutlassfish: One, collected July 1, 1903, from stomach of host. Note on alcoholic specimen: Neck short, arched; body plump, crossed by fine wrinkles; length, 17 mm.; breadth, 8 mm.; thickness, 6.5 mm.; breadth of neck at base, 4 mm., at level of oral sucker, 2.5 mm. Mr. Edwards reported that the worm when living was elongated but contracted when placed in alcohol.

The anatomy, as revealed by a series of cross sections, agrees closely with Manter's description and figures of *H. fusca*. Details of the genital ducts in the vicinity of the shell gland, as interpreted from sections, are shown in figure 150. The ova are not of uniform size, and are somewhat smaller than those in the distome from the swordfish and horse mackerel. The largest noted measured 0.036 by 0.027 mm.; average dimensions of eight of the larger ova were 0.028 by 0.021 mm.

The prostatic portion of the ejaculatory duct is nearly straight, thus differing from the distomes of the swordfish and horse mackerel in which it is more or less coiled. The ejaculatory duct, surrounded by prostatic cells, enters the muscular genital papilla near the dorsal side of the neck, extends back for a short distance, about 35 sections of the series, along the dorsal region, then, at about section 130, turns abruptly ventrad to the seminal vesicle at about the middle of the length of the ventral sucker. The seminal vesicle, sections 115-158 of the series, is tubular and loosely coiled, as many as six divisions of it appearing in a single section. The first (left) testis begins dorsal to the posterior edge of the ventral sucker, and occupies sec-

tions 202-242. The right testis lies close beside the left in sections 215-231. The ovary is subglobular and lies close to the testes on their ventral border in sections 231-244. The tubular vitellaria appear in sections 197-304, which is from the posterior margin of the ventral sucker to a point a short distance back of the middle of the length of the body. The uterus, exclusive of the slender anterior portion, metraterm, begins anteriorly dorsal to the posterior border of the ventral sucker and extends back to about the middle of the length of the body. Its voluminous folds are filled with enormous numbers of small ova. The metraterm, opening behind the genital papilla, at about section 80, passes back for a short distance on the ventral side of the ejaculatory duct and prostate, as a muscular-walled duct surrounded by gland cells. At section 113 it turns abruptly ventrad in front of a similar ventral turn of the ejaculatory duct. At section 117 the metraterm, now near the dorsal border of the ventral sucker, and with still a rather thick muscular wall, but without gland cells, passes back as a straight duct ventral to the seminal vesicle, to about the 193rd section, where it becomes convoluted, and is filled with ova. Ova occur also in the straight portion, but not uninterruptedly.

This specimen was somewhat macerated, giving to the cuticle in some places the appearance of being finely papillate.

From swordfish: Two, collected July 15, 1904, from stomach. Length, 25 mm.; diameter of neck, 1.5 mm., of body at level of ventral sucker, 4.5 mm.; maximum diameter, 6.5 mm. Color pink to reddish, with dark blotches, due to contents of intestine; coarse transverse wrinkles on ventral side of posterior half of the body. While the specimen was under examination many elongated, cylindrical egg masses were ejected from the genital pore behind the oral sucker; largest ova, 0.036 by 0.025 mm.

One, collected July 20, 1904, from stomach. General color brick red, intestines showing as black lines. Neck very actively contractile, changing rapidly from 2 to 10 mm. in length. The body did not show much activity. Length, when fixed in alcohol, 8.5 mm.

Two, collected July 13, 1911, from stomach. Color of body magenta, black intestines showing through body wall; neck paler, oral sucker whitish. Specimen, after lying in sea water over night, measured 28 mm. in length; body nearly cylindrical, 5 mm. in diameter; neck actively extending and contracting, stretching to 9 mm. or more, when it became quite slender.

Twenty-five, collected July 20, 1912, from stomach; pink to brick red; length of largest in life over 30 mm. Largest in alcohol: Length, 24 mm.; breadth, 7 mm.; thickness, 5.3 mm.; smallest, length, 11 mm.; breadth, 2.5 mm.

Twenty-two (U.S.N.M. No. 8312) collected August 8, 1927, from stomach of host; 10 to 36 mm. in length; pale pink to brick red; necks in some translucent; intestine filled with black material.

Subfamily DEROGENETINAE Odhner, 1927

Genus DEROGENES Lühe, 1900

DEROGENES VARICUS (Müller)

PLATE 12, FIGURES 128-133

Derogenes varicus (Müller), NICOLL, Parasitology, vol. 3, p. 348, 1910.—MANTER, Journ. Parasit., vol. 13, p. 17, 1925; Illinois Biol. Mon., vol. 10, no. 2, p. 103, fig. 57, 1926.—FUHRMANN, Handb. Zool., vol. 2, p. 109, fig. 133, 1928.

This species was found by Manter in 6 species of marine fishes. Nicoll reports it from 19 species of British marine fishes. Although recorded from a large number of hosts it is reported to occur only in small numbers.

Three specimens, one from each of three species of fishes, in the collection from Woods Hole fishes appear to belong to this species. The anatomy is incompletely shown in each, but so far as it is shown the agreement with this species is close.

Hosts.—Common codfish (*Gadus morrhua*), flasher (*Lobotes surinamensis*), fishingfrog (*Lophius piscatorius*).

Record of collections.—One (U.S.N.M. No. 8313), from common codfish, collected December 13, 1894, associated with 52 specimens of *Hemiurus levinseni*. Measurements in balsam: Length, 1.56 mm.; breadth, 0.39 mm.; diameter of oral sucker, 0.19 mm., pharynx, 0.09 mm., ventral sucker, 0.33 mm.; ova, 0.054 by 0.033 mm., shells thick; distance from anterior end to ventral sucker, 0.77 mm., from posterior end to ventral sucker 0.63 mm.; many of ova capped at one end.

From flasher: One (U.S.N.M. No. 8314), collected September 1, 1910. Measurements in balsam: Length, 2.00 mm., breadth, at level of ventral sucker, 0.53 mm., elsewhere from 0.28 to 0.42 mm.; oral sucker, length, 0.18 mm., breadth, 0.21 mm.; pharynx, length, 0.11 mm., breadth, 0.10 mm.; ventral sucker, length, 0.36 mm., breadth, 0.39 mm.; ova, average of ten, 0.051 by 0.036 mm., largest about 0.054 mm. by 0.036 mm., shells thick; anterior end to ventral sucker, 0.98 mm. There appears to be but one vitelline gland, posterior to the ovary on the right side. The anterior end was very mobile in the living worm.

From fishingfrog: One (U.S.N.M. No. 8315), collected August 30, 1920. Measurements in balsam: Length, 1.19 mm.; breadth, 0.36 mm.; diameter oral sucker, 0.14 mm., pharynx, 0.06 mm., ventral sucker, 0.28 mm.; ova, average of six, 0.047 by 0.032 mm., largest 0.054 by 0.039, shells thick; distance from anterior end to the ventral sucker, 0.59 mm.; few ova capped.

Genus GENARCHES Looss, 1902

GENARCHES MÜLLERI (Levinsen)

PLATE 22, FIGURES 298, 299; PLATE 23, FIGURE 300

Distomum mulleri LEVINSSEN, Overs. Danske Vidensk. Selks. Forh., 1881, p. 56, pl. 2, fig. 3.

Progonus mulleri (Levinsen), Looss, Zool. Jahrb., vol. 12, p. 642, 1899.

Genarches mülleri (Levinsen), Looss, Zool. Jahrb., vol. 16, p. 732, 1902.—

ODHNER, Die Trematoden des arktischen Gebietes, Fauna Arctica, vol. 4, pp. 365, 366, pl. 4, figs. 8, 9, 1905.

Three, fusiform, rusty, yellowish-red distomes from the lumpfish are referred to this species. On account of the large number of eggs in each of them, but few details of the anatomy can be made out.

The body is smooth, ventral sucker much larger than oral and situated about the middle, or a little back of the middle; pharynx much smaller than the oral sucker; no prepharynx; esophagus very short, genital pore median, at posterior end of pharynx; cirrus short, smooth; cirrus pouch small, a little behind the pharynx; seminal vesicle posterior to the cirrus pouch; testes at posterior border of ventral sucker, nearly opposite; vitelline glands two, subglobular, opposite, near posterior end; ovary to right of median line at the anterior border of the right vitelline gland; seminal receptacle behind the ovary and between the vitellaria. The thick-shelled ova fill the greater part of the body from the posterior end to the genital pore. Ova, 0.048 to 0.054 mm. by 0.033 mm., in balsam.

TABLE 28.—Measurements of two specimens of *Genarches mülleri* in balsam

| Measurement | 1 ¹ | 2 ¹ |
|-------------------------------------|----------------|----------------|
| | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 2.34 | 2.52 |
| Breadth..... | .70 | .66 |
| Anterior end to ventral sucker..... | .94 | 1.17 |
| Oral sucker, length..... | .29 | .24 |
| Oral sucker, breadth..... | .29 | .31 |
| Pharynx, length..... | .07 | .07 |
| Pharynx, breadth..... | .11 | .10 |
| Ventral sucker, length..... | .49 | .42 |
| Ventral sucker, breadth..... | .49 | .35 |

¹ Ventral view.

² Lateral view.

GENARCHES INFIRMUS, new species

PLATE 23, FIGURES 301, 302

Smooth, fusiform, greatest diameter about at level of ventral sucker; neck somewhat elongated, ventral sucker, except when the neck is contracted, being but little in front of the middle; oral

sucker subterminal, with a tuberclelike prolongation of the body in front; no prepharynx; pharynx about half the diameter of the oral sucker, or less. In most cases the esophagus appeared to be shorter than the pharynx, on account of the very contractile neck, but in the specimen sketched, fig. 301, the esophagus is longer than the pharynx, and has rather thick walls. The genital pore is on the median line behind the forking of the intestine; cirrus smooth; cirrus pouch elongate, fusiform, enclosing cells of the prostate and, at its posterior end, the seminal vesicle. The posterior end of the cirrus pouch is at the anterior edge of the ventral sucker, or slightly overlapping it dorsally. Testes near posterior edge of ventral sucker, diagonally placed; ovary behind testes and in front of the two vitellaria, which are near the posterior end, and transverse, or, in some cases slightly diagonal. The uterus extends from the level of the vitellaria to the ventral sucker; ova about 0.04 by 0.02 mm.

TABLE 29.—Measurements of five specimens of *Genarches infirmus* in balsam

| Measurements | 1 | 2 | 3 | 4 | 5 |
|---|------------|------------|------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 2.00 | 1.89 | 1.68 | 2.00 | 2.31 |
| Breadth, level of oral sucker..... | .08 | .12 | .15 | .14 | .15 |
| Breadth, level of ventral sucker..... | .35 | .28 | .42 | .42 | .35 |
| Breadth, near posterior end..... | .08 | .10 | .13 | .11 | .08 |
| Oral sucker, length..... | .15 | .12 | .14 | .12 | .15 |
| Oral sucker, breadth..... | .14 | .12 | .14 | .13 | .14 |
| Pharynx, length..... | .07 | .06 | .06 | .06 | .07 |
| Pharynx, breadth..... | .07 | .07 | .07 | .07 | .08 |
| Ventral sucker, length..... | .29 | .21 | .26 | .24 | .29 |
| Ventral sucker, breadth..... | .27 | .29 | .29 | .28 | .28 |
| Ova, 0.036 by 0.018 to 0.042 by 0.021 mm. | | | | | |

Type specimens.—U.S.N.M. No. 8317 (holotype and paratypes).

Host.—Chinook salmon (*Oncorhynchus tshawytscha*).

Record of collections.—Eight (U.S.N.M. No. 8317), collected May 17, 1898, from stomach of young salmon. Pinole, San Pablo Bay, California.

Six, collected November 17, 1898, from stomach of young salmon. Battle Creek, California.

GENARCHES species

PLATE 23, FIGURES 303, 304

Body smooth, long oval-elliptical, not differing much in breadth throughout, bluntly rounded at each end; ventral sucker approximately twice the diameter of the oral sucker; pharynx about half the diameter of the oral sucker; no prepharynx; esophagus, if any,

very short; rami of intestine extend to posterior end of body. Genital pore behind oral sucker; cirrus pouch short, with thick walls, partly overlapping anterior edge of ventral sucker; testes obscured by the ova, but appear to be not far back of the ventral sucker, and nearly transverse; ovary behind testes, on right side of the median line; vitellaria two, opposite, behind the ovary and near the posterior end; ova scattered through the postacetabular region, from near the posterior end to the ventral sucker; shells of ova not much collapsed.

Measurements in balsam: Length, 1.05 mm.; breadth, at level of oral sucker, 0.21 mm., at level of ventral sucker, 0.38 mm., maximum 0.39 mm.; oral sucker, diameter, 0.17 mm.; pharynx, diameter about 0.07 mm.; ventral sucker, length, 0.28 mm., breadth, 0.34 mm.; ova, average of 10, 0.040 by 0.023 mm.

Host.—Chinook salmon (*Oncorhynchus tshawytscha*).

Two distomes (U.S.N.M. No. 8318) found on slide with specimens of *Genarches infirmus*.

Measurements of smaller specimen: Length, 0.84 mm.; breadth, at level of oral sucker, 0.15 mm., at level of ventral sucker, 0.28 mm.; diameter of oral sucker, 0.12 mm., of pharynx, 0.06 mm., of ventral sucker, 0.23 mm.; ova, 0.039 by 0.039 by 0.018 mm., to 0.042 by 0.021 mm.

Subfamily HEMIURINAE Looss, 1899

Genus HEMIURUS Rudolphi, 1809

HEMIURUS APPENDICULATUS (Rudolphi)

PLATE 8, FIGURES 68-74

Distomum appendiculatum Rudolphi, LINTON, Bull. U. S. Fish Comm., for 1899, p. 289, 1900; *ibid.*, p. 415, 1901 (list of hosts with page references).

The small appendiculate distomes referred to this species have been found in many species of fishes in the Woods Hole region.

Their frequent occurrence in young fishes which feed on the intermediate hosts of this distome (copepods, etc.), and which themselves in turn become the food of a variety of fishes, doubtless accounts for the wide distribution of the species.

The following description from notes made on material from the herring (*Clupea harengus*) applies in general to forms from other hosts. Additional data will be found in the record of collections.

Body more or less fusiform, crossed anteriorly by fine lines producing serrate margins. These annulations are rather faintly shown on many of the smaller specimens. So far as my material shows, the appendix, when fully extended, is about half the length of the body. The oral and ventral suckers are near together, and the diameter of

the ventral sucker is about twice that of the oral. The diameter of the pharynx is about half that of the oral sucker. There is no esophagus, and the intestinal rami extend to the posterior end of the appendix. The genital pore is at the posterior margin of the oral sucker. The seminal vesicle is behind the ventral sucker and in front of the testes, which are near together and diagonally placed. The ovary and vitellaria are situated toward the posterior end of the body and are separated from the testes by folds of the uterus. The ovary is more or less oval in outline, the longer diameter transverse. The two vitellaria lie at the posterior margin of the ovary, and, so far as observed in material from the herring, they appear to be but little lobed. The folds of the uterus were observed to enter the appendix for a short distance. The ova measure about 0.024 by 0.014 mm. in the two principal diameters. In balsam mounts the ova are usually collapsed and much crowded together.

Hosts.—Filefish (*Ceratacanthus schoepfi*), menhaden (*Brevoortia tyrannus*), common herring (*Clupea harengus*), round herring (*Etrumeus sadina*), common eastern stickleback (*Gladionculus bispinosus*), rudderfish (*Palinurichthys perciformis*), summer flounder (*Paralichthys dentatus*), pollack (*Pollachias virens*), glut herring (*Pomolobus aestivalis*), hickory shad (*Pomolobus mediocris*), alewife (*Pomolobus pseudoharengus*), winter flounder (*Pseudopleuronectes americanus*), common mackerel (*Scomber scombrus*), rudderfish (*Seriola zonata*), common scup (*Stendtomus chrysops*), striped anchovy (*Anchoviella epsetus*), lizardfish (*Synodus foetens*), cunner (*Tautoglabrus adspersus*), codling (*Urophycis tenuis*).

Record of collections.—From filefish: One, collected August 7, 1905. Measurements in balsam: Length, 1.54 mm.; breadth, 0.35 mm.; diameter oral sucker, 0.06 mm., pharynx, 0.04 mm., ventral sucker, 0.15 mm.; ova, 0.021 by 0.012 mm.

From menhaden: One, collected August 26, 1903; immature, very active, length varying from 0.6 to 1.2 mm.; excretory vessel filled with spherical bodies; seminal vesicle filled with sperm. One, collected July 11, 1905; measurements in balsam: Length 1.18 mm., breadth 0.19 mm.; length of appendix, 0.45 mm.; diameter of oral sucker 0.06 mm., pharynx 0.04 mm., ventral sucker 0.11 mm.; ova about 0.024 by 0.012 mm.

From common herring: Two, collected August 14, 1905; length 0.8 mm.; ova 0.024 by 0.012 mm. One hundred and fifteen distomes (U.S.N.M. No. 8319) collected July 1 to August 29, 1919, from 20 small fish, measuring from 40 to 85 mm. in length; smallest number in one fish one, largest number in one fish 20; some adult with ova. Three, collected July 17, 1920, from a 75-mm. fish. One, collected July 17, 1920, from a 75-mm. fish. Two, collected August 17, from a 60-mm. fish.

From round herring: Small appendiculate distomes were found in young round herring in 1908 on two dates in July and on five dates in August. Ten distomes were obtained from 110 fishes. Six of these distomes, all immature, belong to the species *H. appendiculatus*. Measurements of one in balsam: Length, 0.58 mm.; breadth, 0.11 mm.; diameter of oral sucker, 0.03 mm., of pharynx, 0.015 mm., of ventral sucker, 0.06 mm. (U.S.N.M. No. 8320).

From common eastern stickleback: One, collected July 20, 1910. Measurements in life: Length, 1.68 mm.; breadth, 0.22 mm.; diameter of oral sucker, 0.07 mm., of pharynx, 0.05 mm., of ventral sucker, 0.18 mm.; ova, 0.027 by 0.012 mm.

From rudderfish (*Palinurichthys perciformis*): Several (U.S. N.M.) No. 8321), collected August 6, 1904. Measurements in balsam: Length, including appendix, 1 mm., breadth, 0.17 mm.; diameter of oral sucker, 0.05 mm., pharynx, 0.02 mm., ventral sucker, 0.09 mm.; ova, 0.02 by 0.01 mm.

Four, immature, collected August 19, 1929. (1) Measurements in balsam, including appendix, 1.96 mm., breadth, 0.28 mm.; diameter oral sucker, 0.04 mm., pharynx, 0.02 mm., ventral sucker, 0.07 mm. (2) Length, 1.75 mm.; breadth, 0.50 mm.; diameter oral sucker, 0.2 mm., pharynx, 0.01 mm., ventral sucker, 0.04 mm.

From common mackerel: One, collected August 3, 1905.

From rudderfish (*Seriola zonata*): Two (U.S.N.M. No. 8327), collected August 16, 1910. Measurements, balsam: Length, including appendix, 1.47 mm.; breadth, 0.25 mm.; diameter oral sucker, 0.06 mm., of pharynx, 0.03 mm., of ventral sucker, 0.12 mm.; ova, collapsed, about 0.024 by 0.012 mm. A note, made at the time of collecting these distomes, states that sperm was seen rotating rapidly in the seminal receptacle, in anticlockwise fashion. The specimen was presumably being observed from the ventral side.

Four, collected August 19, 1929. Measurements in agreement with the foregoing.

From summer flounder: One, collected July 20, 1904. One, collected August 15, 1906.

From pollack: One (U.S.N.M. No. 8322), collected August 19, 1908. Measurements, life: Length, not including appendix, 2.17 mm.; breadth, 0.42 mm.; diameter oral sucker, 0.07 mm., pharynx, 0.04 mm., ventral sucker, 0.17 mm.; ova, 0.027 by 0.010 mm. Length in balsam, 1.40 mm.

From glut herring: Fifty or more, collected September 6, 1910. Lengths from 0.5 mm. to 2.25 mm., all with ova. Measurements of one, life, compressed, appendix retracted, 1.68 mm., breadth, 0.53 mm.; diameter oral sucker, 0.08 mm., pharynx, 0.04 mm., ventral sucker, 0.19 mm., ova 0.027 by 0.010 mm., slightly reniform.

Forty (U.S.N.M. No. 8323), collected September 18, 1913.

From hickory shad: One hundred and fifty, collected August 15, 1906, from intestine of one fish.

Fifty-five (U.S.N.M. No. 8324), collected September 5, 1913, from one fish. Measurements, balsam: Length, including appendix, 1.43 mm.; breadth, 0.32 mm.; length of appendix, 0.53 mm.; diameter oral sucker, 0.08 mm., pharynx, 0.04 mm., ventral sucker, 0.19 mm.; ova, collapsed and crowded together, about 0.024 by 0.012 mm.

From alewife: One, collected July 26, 1906. One (U.S.N.M. No. 8325), collected August 30, 1910.

Eight distomes from this host in old collection, in balsam, have an average length of 1.88 mm.; average length of body, 1.25 mm.; of appendix, 0.63 mm.; maximum length, 2.59 mm., minimum, 1.24 mm. Measurements of one in balsam: Length, including appendix, 2.56 mm.; breadth, 0.36 mm.; diameter oral sucker, 0.07 mm., pharynx, 0.04 mm., ventral sucker, 0.14 mm.; ova, collapsed and crowded, about 0.024 by 0.012. At the time of collecting, sperm was noted in rapid rotary motion in the seminal receptacle, while quiescent sperm filled the early portion of the uterus at the posterior border of the ovary.

Note on distomes found in the food of young alewives, August 27, 1920: Thirty distomes were counted in a small bit of debris from the intestine of a 50-mm. fish; length of distomes about 0.33 mm. One hundred and fifty were counted in the bottom of a dish in which the contents of the stomach and intestine of a 57-mm. alewife had been washed; lengths of distomes from 0.35 to 0.70 mm. Others were noted in a 57, a 65, and a 72-mm. fish. Measurements of one in balsam: Length, 0.36 mm.; breadth, 0.14 mm.; diameter of oral sucker, 0.06 mm., ventral sucker, 0.09 mm.; ova, 0.021 by 0.012 mm.

From winter flounder: Following is a summary of appendiculate distomes referred to the species *H. appendiculatus*, noted while examining young winter flounders for their food:

TABLE 30.—*Record of distomes of Hemiuirus appendiculatus from young Pseudopleuronectes americanus*

| Fishes examined | Date collected | Length of fishes | Total distomes | Fishes seized |
|-----------------|-------------------------|------------------|----------------|-----------------|
| | | <i>Mm.</i> | | |
| 10-14..... | July 27, 1915..... | 28 to 58..... | 1 1, 193 | Katama Bay. |
| 8..... | September 9, 1915..... | 72..... | 1 | Sheep-pen Cove. |
| 8..... | September 14, 1915..... | 62 to 128..... | 1 | Great Harbor. |
| 12..... | October 19, 1915..... | 82 to 124..... | 1 | Quisset Harbor. |

¹ Worms mainly from stomachs; smallest number in a single host 3, in a 37-mm. fish; largest number in a single host 317, in a 30-mm. fish.

² From a 72-mm. fish.

³ From a 62-mm. fish.

⁴ From a 120-mm. fish.

Two hundred and sixty-eight collected July 28, 1916, from 12 of 14 fishes, 45 to 74 mm. in length, mainly from stomach; smallest number from one host 2, from a 62-mm. fish; largest number from one host 75, from a 54-mm. fish. Measurements of one in balsam: Length, appendix retracted, 0.87 mm.; breadth, 0.24 mm.; diameter of oral sucker, 0.08 mm., of pharynx, 0.05 mm., of ventral sucker, 0.16 mm.; ova, 0.022 by 0.010 mm.

From common scup: One, immature, collected August 19, 1919, from a 36-mm. fish. Measurements, in balsam: Length of body, 0.63 mm.; of appendix, 0.28 mm.; breadth, 0.14 mm.; diameter of oral sucker, 0.04 mm., of pharynx, 0.02 mm., of ventral sucker, 0.08 mm.

From striped anchovy: Numerous, collected August 15, 1906. These distomes agree with distomes found in the hickory shad (*Pomolobus mediacris*) on the same date, but were smaller. Specimens mounted in balsam are from 0.7 to 0.84 mm. in length, not including the appendix. Measurements in balsam, lateral view: Length, 0.84 mm.; breadth, 0.18 mm.; diameter of oral sucker, 0.045 mm., of pharynx, 0.027 mm., of ventral sucker, 0.09 mm.; ova about 0.024 by 0.012 mm.

From lizardfish: Three (U.S.N.M. No. 8328), collected September 11, 1928; 15 fishes, from 87 to 137 mm. in length, examined. Measurements in balsam: Length, including appendix, 1.17 mm.; length of appendix, 0.35 mm.; breadth, 0.24 mm.; diameter of oral sucker, 0.05 mm., of pharynx, 0.03 mm., of ventral sucker, 0.10 mm.; ova, 0.024 by 0.009 mm.

From cunner: One, immature, collected June 30, 1919, from a 12-millimeter cunner. The distome was actively contractile, varying in length from 0.37 to 0.90 mm.

From codling: One, collected October 29, 1914. Measurements in formalin: Length, 2.4 mm., breadth, 0.45 mm.; length of appendix, 1 mm.; diameter of oral sucker, 0.08 mm.; ventral sucker, 0.17 mm.; ova, 0.028 by 0.011 mm. Length in balsam, 1.76 mm.

Four, collected July 20, 1929; 3 fishes examined.

Twenty-two (U.S.N.M. No. 8329), collected August 7, 1929, from one fish.

HEMIURUS LEVINSANI Odhner

PLATE 8, FIGURES 75-77

Distomum ocreatum Molin (part), LINTON, Bull. U. S. Fish Comm. for 1899, p. 288, pl. 35, fig. 19, 1900.

Hemiurus levinseni ODHNER, Die Trematoden des arktischen Gebietes, Fauna Arctica, vol. 4, pp. 348-351, pl. 4, fig. 2, 1905.—MANTER, Illinois Biol. Mon., vol. 10, No. 2, pp. 92, 93, figs. 62, 63, 1926.

Hemiurus levinseni Odhner, MANTER, Journ. Parasit., vol. 12, p. 13, 1925.

This species, which resembles *H. appendiculatus* in many of its characters, differs from that species markedly in the relative size of the suckers. Whereas the diameter of the ventral sucker in *H. appendiculatus* is about twice that of the oral sucker, in *H. levinsoni* the suckers are nearly equal, the oral sucker often being slightly larger than the ventral.

Hosts.—Lumpfish (*Cyclopterus lumpus*), common codfish (*Gadus morrhua*), tilefish (*Lopholatilus chamaeleonticeps*), whiting (*Merluccius bilinearis*), pollack (*Pollachius virens*), codling (*Urophycis chuss*).

Record of collections.—One (U.S.N.M. No. 8330), collected July 10, 1926, from lumpfish. Measurements in balsam: Length, 1.26 mm., breadth, 0.53 mm.; diameter of oral sucker, 0.15 mm., of pharynx, 0.07 mm., of ventral sucker, 0.13 mm.; ova, much crowded and difficult to measure, about 0.018 by 0.012 mm.

From common codfish: Fifty-three (U.S.N.M. No. 8331), collected December 13, 1894, from one cod. Measurements in formalin: Length, 2.73 mm.; breadth, 0.41 mm.; diameter of oral sucker, 0.22 mm., of pharynx, 0.11 mm., of ventral sucker, 0.22 mm.; ova, 0.025 by 0.014 mm. Average of six in balsam, lengths from 1.26 to 2.03 mm.: Length, 1.71 mm.; breadth, 0.39 mm.; diameter of oral sucker, 0.20 mm., of pharynx, 0.10 mm., of ventral sucker, 0.19 mm.; length of appendage, 0.26 mm.; ova, 0.024 by 0.012 mm.

One, collected December 21, 1903; 30 fishes examined. Five, collected July 15, 1926; 4 fishes examined.

The eggs in most of these distomes from the cod are not collapsed and appear to be distinctly larger than those in the distomes from the pollack, etc. In one of the mounted specimens, however, some of the eggs are collapsed and resemble those in distomes from other hosts rather closely.

From tilefish: *Distomum ocreatum* Molin, Bull. U. S. Fish Comm. for 1899, p. 472, 1901. One of the larger specimens from this host (U.S.N.M. No. 8332) has the following dimensions, in balsam: Length, 2.38 mm., breadth, 0.42 mm.; diameter of oral sucker, 0.21 mm., pharynx, 0.10 mm., ventral sucker, 0.21 mm.; ova, 0.023 by 0.012. The seminal vesicle was not seen distinctly to be in two sections, and the prostate begins a little in front of the ventral sucker.

From whiting: One, collected July 23, 1923. Measurements, balsam: Length, 0.98 mm., breadth, 0.25 mm.; diameter of oral sucker, 0.12 mm., of pharynx, 0.06 mm., of ventral sucker, 0.10 mm.; ova crowded and collapsed, about 0.018 by 0.009 mm.

One (U.S.N.M. No. 8333), collected July 15, 1924. Measurements, balsam: Length, 1.40 mm. (posterior end missing); breadth, 0.30

mm.; diameter oral sucker, 0.18 mm., of pharynx, 0.08 mm., of ventral sucker, 0.15 mm.; ova, 0.021 by 0.012 mm.

From pollack: One (U.S.N.M. No. 8334), collected July 31, 1924. Measurements in balsam: Length, appendix retracted, 1.54 mm.; breadth, 0.57 mm.; diameter of oral sucker, 0.17 mm., of pharynx, 0.08 mm., of ventral sucker, 0.13 mm.; ova, much crowded and collapsed, about 0.018 by 0.012 mm. The prostate appears to begin slightly in front of the ventral sucker, but the neck of the specimen is strongly contracted. If the neck were straightened the anterior prostatic cells would be about on a level with the anterior border of the ventral sucker.

In the distomes from both the whiting and pollack the seminal vesicle was in two sections, characteristic of the species.

From codling: One, collected August 19, 1910.

HEMIURUS species

Host.—Mousefish (*Histrio pictus*).

Record of collections.—One (U.S.N.M. No. 8355), immature, collected September 5, 1919. Measurements, life: Length, 0.60 mm., breadth, 0.21 mm.; diameter of oral sucker, 0.10 mm., of ventral sucker, 0.14 mm. Cuticle smooth, intestinal rami voluminous, appendix short, retracted.

Measurements in balsam: Length, 0.84 mm.; breadth, 0.24 mm.; diameter of oral sucker, 0.10 mm., of pharynx, 0.05 mm., of ventral sucker, 0.14 mm.

Genus BRACHYPHALLUS Odhner, 1905

BRACHYPHALLUS CRENATUS (Rudolphi)

PLATE 11, FIGURES 109-120

Distomum ocreatum Molin, LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 514, 515 pl. 42, fig. 12 (from *Pomotomus saltatriæ*), 1898; in Linton, Bull. U. S. Fish Comm. for 1899, p. 288, figs. 16, 17 (not fig. 19) (from *Pollachias virens*), 1900.

Hemiurus crenatus (Rudolphi), LANDER, Contr. Harvard College, No. 148, pp. 1-28, 4 pls., 1904.

Brachypallus crenatus (Rudolphi), ODHNER, Die Trematoden des arktischen Gebietes, Fauna Arctica, pp. 352, 353, pl. 4, figs. 3-5, 1905.—Looss, Zool. Jahrb., vol. 26, pp. 158, 159, figs. 64, 65, 1907.—MANTER, Journ. Parasit., vol. 12, p. 13, 1925; Illinois Biol. Mon., vol. 10, No. 2, pp. 94, 95, fig. 53, 1926.

Brachypallus affinis (= *B. crenatus* C. H. Lander, 1904) Looss, Zool. Jahrb., vol. 26, pp. 158, 159, 1907.

The distomes referred to this species in this report are characterized by having a nearly linear body which is crossed by fine lines producing sharply serrate margins in robust specimens; in many cases

the serrations are faint, or have disappeared entirely. The oral and ventral suckers are nearly equal and are separated from each other by a space approximately equal to the diameter of one of them. The diameter of the pharynx is about half that of the oral sucker. Prepharynx and esophagus none, intestinal rami extend to end of appendix. The genital pore is on the midventral line about half-way between the oral and ventral suckers. The cirrus-pouch is short, and the seminal vesicle is dorsal to the anterior border of the ventral sucker. The two testes are close behind the ventral sucker, near together, and slightly diagonal; they vary from circular to oval-elliptical in outline. The ovary is situated toward the posterior end of the body proper, and is usually oval-elliptical in outline, with the longer diameter transverse. The vitellaria lie immediately behind the ovary. They are lobed, and while there is considerable variation in the lobation, the right one was usually three-lobed and the left two-lobed.

The seminal receptacle and shell gland lie behind the ovary between the vitellaria. The folds of the uterus are voluminous and fill the body between the ventral sucker and ovary; folds of the uterus extend back of the ovary and vitelline glands but were not observed to enter the appendix. Ova, in balsam, about 0.024 mm. by 0.012 mm.

The above description is based on specimens from the eel.

Hosts.—Sand launce (*Ammodytes americanus*), American eel (*Anguilla rostrata*), common herring (*Clupea harengus*), sea raven (*Hemitripterus americanus*), fishingfrog (*Lophius piscatorius*), silversides (*Menidia notata*), kingfish (*Menticirrhus saxatilis*), silver hake (*Merluccius bilinearis*), tomcod (*Microgadus tomcod*), white perch (*Morone americana*), American smelt (*Osmerus mordax*), pollock (*Pollachius virens*), hickory shad (*Pomolobus mediocris*), bluefish (*Pomatomus saltatrix*), remora (*Remora remora*), common mackerel (*Scomber scombrus*), codling (*Urophycis chuss*), codling (*Urophycis tenuis*).

Record of collections.—From sand launce, one and fragment collected July 5, 1912. Measurements, life: Length, appendix partly retracted, 0.84 mm.; breadth, 0.32 mm.; diameter of oral sucker, 0.13 mm., pharynx, 0.05 mm., ventral sucker, 0.17 mm.; ova, 0.024 by 0.012 mm. In the fragment the diameter of the oral sucker was 0.14 mm., ventral sucker, 0.15 mm.

One, collected October 29, 1913; length, 2 mm. in formalin. Six (U.S.N.M. No. 8336), collected November 1, 1913; 2 to 4 mm. in formalin, appendix everted. One, collected October 13, 1914; length in formalin, appendix retracted, 1.73 mm., breadth 0.54 mm.; diameter of oral sucker 0.22 mm., ventral sucker 0.23 mm., ova 0.028 by

0.14 mm. Three, collected October 20, 1914. Twenty-two, collected November 5, 1914.

From American eel: One, collected December 6, 1909. Seven (U.S.N.M. No. 8337), collected June 13, 1913; 1.40 mm. to 2.47 mm., excluding appendix, in formalin. Forty, collected July 10, 1914, in washings from intestines of 9 eels. Dr. G. A. MacCallum also found a number on the gills.

Average measurements of nine specimens mounted in balsam, and varying in length from 1.26 to 1.92 mm.: Length, 1.42 mm.; breadth, 0.36 mm.; diameter of oral sucker, 0.136 mm., pharynx, 0.06 mm., ventral sucker, 0.139 mm.; ova, 0.024 by 0.012 mm.

From common herring: One, collected November 11, 1904; length, 2.5 mm. in formalin. One, collected November 4, 1911; length, 3.7 mm. in formalin. Two, collected November 8; length, 3 mm. in formalin. Three, collected July 17, 1920. Three (U.S.N.M. No. 8338), collected August 17, 1920, from a 60-mm. fish. Measurements, life: Length, 2.10 mm., breadth, 0.49 mm.; diameter of oral sucker, 0.25 mm., of ventral sucker, 0.25 mm.

These distomes from the herring when compared with those from the eel agree in those characters which have been enumerated. Differences in outline of the vitellaria occur, but in general they resemble those of the eel distomes, varying from obscurely lobed to distinctly lobed examples.

Average measurements of eight in balsam varying in length from 1.05 to 2.10 mm.: Length, 1.66 mm.; breadth, 0.40 mm.; diameter of oral sucker, 0.15 mm., pharynx, 0.07 mm., ventral sucker, 0.15 mm.; ova, 0.024 by 0.012 mm.

From fishingfrog: One (U.S.N.M. No. 8340), collected August 3, 1910. Measurements, balsam: Length, ex. appendix, 1.40 mm.; breadth, 0.42 mm.; diameter oral sucker, 0.17 mm., pharynx, 0.08 mm., ventral sucker, 0.17 mm.; ova, collapsed and crowded, about 0.021 by 0.009 mm. One, collected December 6, 1912.

From silversides (*Menidia notata*): A small, immature, yellowish distome, collected August 11, 1919, from a 28-mm. fish, is here recorded. Length, life, 0.24 mm.; breadth, 0.04 mm.; diameter oral sucker, 0.03 mm., ventral sucker, 0.03 mm.

From kingfish: One (U.S.N.M. No. 8341), collected September 9, 1908, from intestine. Measurements in balsam, appendix retracted: Length, 1.76 mm.; breadth, 0.36 mm.; diameter oral sucker, 0.16 mm., pharynx, 0.08 mm., ventral sucker, 0.17 mm.; ova, 0.021 by 0.012 mm.

One, collected July 19, 1910. Measurements, life, appendix partly retracted: Length, 1.50 mm.; breadth, 0.28 mm.; ova, 0.028 by 0.016 mm. In balsam the diameter of the oral sucker is 0.126 mm., pharynx, 0.06 mm., ventral sucker, 0.135 mm.; ova, 0.021 by 0.012 mm.

From silver hake: One, collected August 15, 1907. One, collected July 29, 1910.

Two, collected August 16, 1910. Measurements, life: Length, including appendix, 2.6 mm.; breadth, 0.67 mm.; diameter oral sucker, 0.25 mm., pharynx, 0.14 mm., ventral sucker, 0.27 mm. Another and larger specimen (U.S.N.M. No. 8342): Length, 4.2 mm.; breadth, 0.70 mm.; diameter of oral sucker, 0.33 mm., pharynx, 0.14 mm., ventral sucker, 0.35 mm.; ova, 0.027 by 0.017 mm.

Five, collected August 19, 1910. Eight, collected May 25, 1911. One, collected July 15, 1924.

From tomcod: One, collected July 30, 1904.

From white perch: Three (U.S.N.M. No. 8343), collected April 21, 1913. Measurements in balsam: Length, appendix retracted, 1.26 mm.; breadth, 0.26 mm.; diameter oral sucker, 0.14 mm., pharynx, 0.07 mm., ventral sucker, 0.17 mm.; ova not developed.

From American smelt: One, collected January 25, 1911.

Two (U.S.N.M. No. 8344), collected February 3, 1911. Lengths in balsam, 1.33, 1.82, and 2.10 mm. Measurements of largest: Length, 2.10 mm.; breadth, 0.63 mm.; diameter oral sucker, 0.25 mm., pharynx, 0.12 mm., ventral sucker, 0.28 mm.; ova, 0.027 by 0.012 mm.

From pollack: Two, collected August 12, 1910: Length in alcohol, 2 mm. One, collected July 1, 1912; length, 3.57 mm.; eighteen fishes examined.

One (U.S.N.M. No. 8345), collected July 31, 1924. Measurements in balsam: Length, 3.80 mm.; breadth, 0.72 mm.; length of appendix, 1.33 mm.; diameter oral sucker, 0.27 mm., pharynx, 0.15 mm., ventral sucker, 0.28 mm.; ova about 0.024 by 0.012 mm.

From hickory shad: Two, collected August 20, 1910; two fishes examined. Six, collected June 17, 1911; five fishes examined. Eight, collected June 21, 1911; two fishes examined. Eighty (U.S.N.M. No. 8346), collected June 21, 1913; length of one in formalin, 1.91 mm.; length of appendix 1 mm.

TABLE 31.—*Measurements of two specimens of Brachyphallus crenatus (U.S.N.M. No. 8346) in balsam, appendices retracted*

| Measurement | 1 | 2 |
|------------------------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 1.22 | 0.82 |
| Breadth..... | .35 | .21 |
| Diameter oral sucker..... | .16 | .12 |
| Diameter pharynx..... | .08 | .05 |
| Diameter ventral sucker..... | .16 | .12 |
| Ova, 0.024 by 0.012 mm. | | |

From bluefish: Two (U. S. N. M. No. 8347), collected July 8, 1911. Measurements in balsam: Length, appendix retracted, 1.47 mm., breadth, 0.27 mm.; diameter oral sucker, 0.20 mm., pharynx, 0.09 mm., ventral sucker, 0.21 mm.; ova, 0.024 by 0.012 mm.

From remora: One, collected July 21, 1911. Measurements in balsam: Length, appendix retracted, 1.82 mm.; breadth, 0.49 mm.; diameter oral sucker, 0.20 mm., pharynx, 0.09 mm., ventral sucker, 0.21 mm.; ova crowded and collapsed, about 0.024 by 0.012 mm. This specimen was not noted at the time of collecting, but appears on a slide containing specimens of *Sterrhurus monticellii*.

From common mackerel: One (U.S.N.M. No. 8348), collected June 6, 1908. Measurements in balsam: Length, appendix retracted, 0.9 mm.; breadth, 0.28 mm.; diameter oral sucker, 0.10 mm., ventral sucker, 0.10 mm.; ova, collapsed, about 0.024 by 0.012 mm.

From codling (*Urophycis chuss*): Few, collected August 19, 1910. Measurements in balsam: Length, appendix retracted, 2.17 mm.; breadth, 0.38 mm.; diameter oral sucker, 0.18 mm., pharynx, 0.08 mm., ventral sucker, 0.18 mm.; ova, 0.024 by 0.012 mm.

From codling (*Urophycis tenuis*): One (U.S.N.M. No. 8349), collected November 3, 1913. Measurements in balsam: Length, appendix retracted, 1.54 mm.; breadth, 0.46 mm.; diameter oral sucker, 0.18 mm., pharynx, 0.07 mm., ventral sucker, 0.21 mm.; ova collapsed and crowded, about 0.024 by 0.012 mm.

Subfamily STERRHURINAE Looss, 1907

Genus STERRHURUS Looss, 1907

STERRHURUS MONTICELLII (Linton)

PLATE 10, FIGURES 101-107

- Distomum monticellii* LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 518-520, pl. 44, figs. 2-8, 1898; Bull. U. S. Fish Comm. for 1899, pp. 451, 473, 482, 1901; Bull. U. S. Bur. Fisheries, vol. 24, p. 334, etc., figs. 154-155, 1905.
Hemurus monticellii (Linton), Looss, Zool. Jahrb., vol. 12, p. 641, 1899.
Sterrhurus monticellii (LINTON), Carnegie Inst. Washington Publ. 133, pp. 61, 62, figs. 139, 140, 1910.

Body smooth, ventral sucker much larger than oral; cirrus pouch small, in neck behind pharynx; seminal vesicle dorsal to anterior border of ventral sucker; testes not far back of ventral sucker, near together and somewhat diagonally placed; ovary separated from testes by folds of the uterus; vitellaria at posterior border of ovary, each deeply lobed; uterus voluminous, its folds extending back of the vitellaria, the early folds containing sperm; ova, 0.015 to 0.024 mm. by 0.009 to 0.012 mm.

Hosts.—*Caranx chrysos*, lumpfish (*Cyclopterus lumpus*), shark-sucker (*Echeneis naucrates*), round herring (*Etrumeus sadina*), little tunny (*Euthynnus alletteratus*), leatherjacket (*Oligoplites saurus*), remora (*Remora remora*), rudderfish (*Palinurichthys perciformis*), bluefish (*Pomatomus saltatrix*), goggler (*Trachurops crumenophthalma*), cutlassfish (*Trichiurus lepturus*).

Record of collections.—From *Caranx chrysos*: One, collected August 8, 1904. Measurements, life: Length, 1.35 mm.; diameter of oral sucker, 0.10 mm.; ventral sucker, length, 0.22 mm., breadth, 0.26 mm.; ova, 0.014 by 0.009 mm.

One (U.S.N.M. No. 8350), collected October 15, 1915. Measurements in balsam: Length, appendix missing, 0.95 mm.; breadth, 0.36 mm.; diameter of oral sucker, 0.11 mm., of pharynx, 0.06 mm., of ventral sucker, 0.23 mm.; ova, 0.014 by 0.009 mm.

From lumpfish: One (U.S.N.M. No. 8351), collected July 10, 1926. Measurements in balsam: Length, appendix retracted, 2.10 mm.; diameter of oral sucker, 0.12 mm., of pharynx, 0.06 mm., of ventral sucker, 0.28 mm.; ova, 0.018 by 0.012 mm.

From sharksucker: Eighty-eight (U.S.N.M. No. 8352), collected August 19, 1903. Alcoholic specimens, much distorted: Length of longest about 3 mm. Average of eight in balsam: Diameter of oral sucker, 0.12 mm., of ventral sucker, 0.32 mm.; ova about 0.020 by 0.012 mm.

From round herring: One, collected July 28, 1908. Measurements in balsam, appendix retracted: Length, 1 mm.; breadth, 0.28 mm.; diameter of oral sucker, 0.10 mm., of pharynx, 0.04 mm., of ventral sucker, 0.22 mm.; ova few, not distinct, about 0.018 by 0.010 mm.

From little tunny: Nine (U.S.N.M. No. 8353), collected August 12, 1905; from 1.8 mm. to 2.6 mm. in length; variety of shapes; color of larger specimens pale pink, others translucent, almost colorless, except where the amber-colored eggs lie; active sperm noted at posterior border of the ovary. Average of four, life: Diameter of oral sucker, 0.14 mm., of ventral sucker, 0.41 mm.; average of seven in balsam, oral sucker, 0.12 mm., ventral sucker, 0.33 mm.

From leatherjacket: One (U.S.N.M. No. 8354), collected July 14, 1924. Measurements in balsam: Length, 2.10 mm.; breadth, 0.45 mm.; diameter of oral sucker, 0.12 mm., of pharynx, 0.06 mm., of ventral sucker, 0.28 mm.; ova collapsed and crowded, about 0.015 by 0.007 mm.

From remora: Nine (U.S.N.M. No. 8355), collected July 28, 1910, from stomach at pyloric opening; pale red, active, with tendency to cling together when placed in sea water; excretory vessels seen to unite above pharynx; right vitelline gland four-lobed, left three-

lobed; sperm seen in active rotary motion at posterior border of ovary.

Thirteen, collected July 21, 1911. Nineteen, collected August 3, 1911, from stomach of host. Five, collected September 9, 1912, from stomach of host. One, collected July 26, 1918.

One, collected July 21, 1919. Measurements, life: Length, appendix retracted, 1.35 mm.; breadth, 0.23 mm.; diameter oral sucker, 0.10 mm., pharynx, 0.06 mm., ventral sucker, 0.21 mm.; ova, 0.024 by 0.012 mm.

From rudderfish: One, collected August 20, 1910, immature, recorded here, but not enough of anatomy shown to admit of satisfactory determination. Length, including appendix, 1.89 mm., in balsam; length of appendix, 0.56 mm.; breadth at level of ventral sucker, 0.48 mm., behind ventral sucker, 0.38 mm.; diameter of oral sucker, 0.19 mm., of pharynx, 0.10 mm., of ventral sucker, 0.35 mm.

From bluefish: "Several," collected July 15, 1904. Two (U.S.N.M. No. 8356), collected July 8, 1911.

From goggler: A small distome and a fragment of another from this host were collected August 27, 1905. Measurements in balsam, appendix retracted: Length, 1.40 mm.; breadth, 0.36 mm.; diameter of oral sucker, 0.10 mm., pharynx, 0.06 mm., ventral sucker, 0.24 mm.; ova, 0.014 by 0.009 mm.

From cutlassfish: Two hundred and sixteen (U.S.N.M. No. 8357), collected June 9, 1903, from mouth of host. Measurements in glycerin: Length, including appendix, 3 mm.; breadth, 0.9 mm.; diameter of oral sucker, 0.16 mm., ventral sucker, 0.38 mm.

Forty-seven, collected June 15, 1903, from mouth of host. Two hundred and forty, collected July 26, 1903, from stomach of host. Two hundred and eighty-three, collected August 6, from stomach of host. Three hundred and thirteen, collected September 16, 1903.

Two fishes taken at Menemsha Bight were examined August 2, 1904. One of them had been in alcohol for several months, the other in formalin for about three days; 317 distomes were collected from the stomachs, most of them from the formalin specimen.

One hundred and forty-three, collected June 18, 1913. Largest, in formalin, 3.5 mm., plump, arcuate. More than 50 specimens of various sizes from this host were either mounted in balsam or cleared in acetic-glycerin. All clearly belong to the same species. Measurements in balsam, average of nine: Diameter of oral sucker, 0.17 mm., of ventral sucker, 0.43 mm.; smallest oral sucker, 0.14 mm., largest, 0.21 mm.; smallest ventral sucker, 0.35 mm., largest, 0.50 mm.; ova about 0.018 by 0.012 mm.

STERRHURUS species

Here is recorded a single distome from *Histrio pictus*, on which the following note was made at the time of collecting, August 9, 1904.

Body smooth, with a few irregular transverse wrinkles; genital aperture at posterior edge of oral sucker; cirrus, cirrus pouch and prostate indistinct; testes transverse at posterior edge of ventral sucker; ovary subglobular, on left side; vitellaria behind ovary, the left one slightly lobed, its anterior border reaching nearly to the middle of the ovary. The rami of the intestine extend to the appendix, but were not seen to enter it.

Measurements in glycerin: Length, 1.23 mm.; breadth, anterior, 0.15 mm., middle, 0.45 mm., posterior, 0.15 mm.; diameter of oral sucker, 0.15 mm., of ventral sucker, 0.28 mm.

Subfamily LEICITHASTERNAE Odhner, 1905

Genus LECITHASTER Lühe, 1901

LECITHASTER CONFUSUS Odhner

PLATE 11, FIGURES 121-124

Distomum bothryophoron OLSSON, LINTON, Bull. U. S. Fish Comm. for 1899, p. 439, figs. 355, 356, 1901.

Lecithaster confusus ODHNER, Die Trematoden des arktischen Gebietes, Fauna Arctica, vol. 4, p. 359, 1905; Zool. Jahrb., vol. 26, p. 164, figs. 70-72, 1907.—LÜHE, in Brauer's Süßwasserfauna Deutschlands, vol. 17, Trematodes, pp. 140, 141, 1909.

Examples of small distomes have been found in a number of Woods Hole fishes which agree closely with forms that appear in the literature of the Trematoda under a variety of specific names, but which are included by Odhner and Lühe in the two species *Lecithaster gibbosus* (Rudolphi) and *L. confusus* Odhner.

Unfortunately many of the specimens in the collection show the anatomy imperfectly.

According to Lühe, following Odhner, the two species may be briefly characterized thus:

L. gibbosus: Lobes of ovary roundish, scarcely longer than broad; lobes of vitellaria slender, tending to pyriform; seminal vesicle dorsal to, and not extending beyond the ventral sucker; ova, 0.025 to 0.027 by 0.013 mm.

L. confusus: Lobes of ovary longish; lobes of vitellaria short, scarcely as long as broad; seminal vesicle extending back of ventral sucker; ova, 0.015 to 0.017 by 0.009 mm.

In those cases in which the seminal vesicle, ovary, and vitellaria are indistinct I have referred those with ova approximating 0.025 by 0.013 mm. to *L. gibbosus*, and those whose ova approximate 0.015 by 0.009 mm. to *L. confusus*.

The distomes referred to the species *L. confusus* are fusiform, anterior end rather bluntly rounded, posterior end tapering; greatest diameter at about level of ventral sucker, or a little behind it; ventral sucker much larger than oral; no prepharynx, esophagus none, or very short; intestinal rami extend to posterior end, in some cases inflated and conspicuous; genital pore about half-way between oral and ventral suckers; ejaculatory duct long, surrounded by prostatic cells; seminal vesicle dorsal to and extending back of the ventral sucker. Testes nearly transversely placed, a short distance behind ventral sucker. Ovary four-lobed, lobes blunt, behind testes; vitellaria behind ovary, seven-lobed, lobes more or less pyriform. The folds of the uterus fill the body from the level of the anterior border of the ventral sucker to the posterior end. The metraterm passes from the dorsal border of the ventral sucker to the genital pore. Ova very numerous and small, approximating 0.015 by 0.009 mm.

The above description is based on material from the hickory shad (*Pomolobus mediocris*).

Hosts.—Black sea bass (*Centropristes striatus*), common herring (*Clupea harengus*), round herring (*Etrumeus sadina*), hickory shad (*Pomolobus mediocris*), dollarfish (*Poronotus triacanthus*), common mackerel (*Scomber scombrus*), puffer (*Sphoeroides maculatus*), cunner (*Tautoglabrus adspersus*).

Record of collections.—From black sea bass: Immature distomes (U.S.N.M. No. 8358), from 0.23 to 0.35 mm. in length, were found on June 30, 1919, in young sea bass, one from a 7-mm. fish, one to four from each of five 9-mm. fish; one, with ova, from a 6-mm. fish. Measurements in formalin: Length, 0.30 mm.; breadth, 0.16 mm.; diameter oral sucker, 0.06 mm., pharynx, 0.03 mm., ventral sucker, 0.09 mm.; ova, 0.015 to 0.018 by 0.009 mm. Seminal vesicle extends back of ventral sucker.

From common herring: Three small distomes, collected August 29, 1919, largest 1 mm. in length, from a 56-mm. herring. Measurements in balsam: Length, 0.70 mm., breadth, 0.21 mm.; diameter oral sucker, 0.06 mm., pharynx, 0.036 mm., ventral sucker, 0.16 mm.; ova collapsed and crowded, about 0.015 by 0.009 mm.

From round herring: Immature distomes belonging to the genus *Lecithaster*. Three, collected August 7, 1908; length, 0.65 mm. Three, collected August 8, 1908; length, 0.50 mm.; breadth, 0.22 mm.; diameter oral sucker, 0.04 mm., pharynx, 0.03 mm., ventral sucker, 0.09 mm. One, collected August 10, 1908; length, 0.57 mm.; breadth, 0.14 mm.; diameter oral sucker, 0.045 mm.; pharynx, 0.03 by 0.04 mm., ventral sucker, 0.10 mm.

From hickory shad: Thirteen, collected June 10, 1907. One (U.S.N.M. No. 8359), collected June 21, 1913; four fishes examined:

Length, in formalin, 0.9 mm.; breadth, 0.42 mm.; diameter of oral sucker, 0.14 mm., ventral sucker, 0.28 mm.; ova, 0.020 by 0.013 mm. The ova in balsam are thin-shelled and difficult to measure, about 0.015 by 0.009 mm.

Seven (U.S.N.M. No. 8360), collected September 5, 1913. Measurements in formalin from length 0.91 mm. and breadth 0.44 mm. to length 1.75 and breadth 0.63 mm.; ova in balsam, about 0.015 by 0.009 mm.

The lobes of the ovary seemed to be at least as long as broad; lobes of vitellaria about as long as broad.

TABLE 32.—*Measurements of six specimens of Lecithaster confusus in balsam*

| Measurement | 1 ¹ | 2 | 3 | 4 | 5 | 6 |
|------------------------------|----------------|------|------|------|------|------|
| | Mm. | Mm. | Mm. | Mm. | Mm. | Mm. |
| Length..... | 1.33 | 1.26 | 0.94 | 1.00 | 1.15 | 1.54 |
| Breadth..... | .54 | .58 | .39 | .43 | .35 | .65 |
| Oral sucker, length..... | .15 | .14 | .08 | .10 | .10 | .14 |
| Oral sucker, breadth..... | .16 | .13 | .08 | .11 | .10 | .13 |
| Pharynx, length..... | .09 | .10 | .04 | .04 | .06 | .08 |
| Pharynx, breadth..... | .08 | .10 | .04 | .04 | .05 | .07 |
| Ventral sucker, length..... | .25 | .26 | .19 | .24 | .19 | .25 |
| Ventral sucker, breadth..... | .24 | .21 | .14 | .17 | .18 | .22 |
| Ova, 0.015 by 0.009 mm. | | | | | | |

¹ No. 1, ventral view, others lateral view.

From dollarfish: One, collected July 20, 1919, from a 12-mm. fish. Measurements in balsam: Length, 0.7 mm.; breadth at level of ventral sucker, 0.28 mm., behind ventral sucker, 0.22 mm.; diameter oral sucker, 0.06 mm., pharynx, 0.04 mm., ventral sucker, 0.15 mm.; ova, 0.012 by 0.007 mm.

From common mackerel: Eight (U.S.N.M. No. 8361), collected August 23, 1919, from a 16-mm. fish and ten from a 22-mm. fish. Measurements, life: Length, 0.52 mm.; breadth, 0.25 mm.; diameter oral sucker, 0.06 mm., pharynx, 0.04 mm., ventral sucker, 0.16 mm.; ova, 0.015 by 0.009 mm.

One, collected August 28, 1919, from an 11-mm. fish; length, 0.33 mm.

Three from a 10-mm. fish. Measurements of one, life: Length, 0.45 mm.; breadth, 0.18 mm.; diameter oral sucker, 0.06 mm., ventral sucker, 0.11 mm.; ova, 0.015 by 0.009 mm. Lobes of vitellaria slightly pyriform.

From puffer: Four, collected July 7, 1919, from a 10-mm. fish, two from each of two 9-mm. fish, and two from a 7-mm. fish. Measurements, life: Length, 0.98 mm., breadth, 0.40 mm.; diameter oral sucker, 0.98 mm., pharynx, 0.05 mm., ventral sucker, 0.18 mm.; ova 0.015 by 0.010 mm.

One (U.S.N.M. No. 8362), collected July 25, 1919, from a 7-mm. fish. Lobes of vitellaria short, about as broad as long.

From cunner: One to five immature distomes, collected June 30, 1919, 0.27 to 0.46 mm. in length, from each of nine young cunners from 9 to 15 mm. in length. One distome with ova from a 9-mm. fish.

Five, collected July 15, 1919, from a 10-mm. fish. Eight, collected July 21, 1919, from a 12-mm. fish.

Five (U.S.N.M. No. 8363), collected July 25, 1919, from a 10-mm. fish. Measurements in balsam: Length, 0.38 mm.; breadth, 0.24 mm.; diameter oral sucker, 0.07 mm., ventral sucker, 0.12 mm.; ova, 0.018 by 0.009 mm.

Twelve, collected August 21, 1919, from a 21-mm. fish, and one from a 20-mm. fish.

One distome from the stomach of a small cunner was still apparently in place in a copepod.

Average measurements of nine distomes from young cunners: Length, 0.33 mm.; breadth, 0.19 mm.; diameter of oral sucker, 0.06 mm., ventral sucker, 0.10 mm.

Note on a living specimen, July 15, 1919: Testes close behind ventral sucker; ovary behind testes; vitellaria posterior to ovary, lobed in manner characteristic of the genus *Lecithaster*; seminal receptacle a little way behind level of testes, dorsal; seminal vesicle dorsal to ventral sucker, ejaculatory duct surrounded by coarse prostatic cells; cirrus not evident; intestines reach to near posterior end; folds of uterus amid other organs, from posterior end to ventral sucker; metraterm passing dorsal to ventral sucker to genital pore.

LECITHASTER GIBBOSUS (Rudolphi)

PLATE 11, FIGURES 125, 126

Distomum bothryophoron OLSSON, LINTON, Bull. U. S. Fish Comm. for 1899, p. 437 (from *Clupea harengus*), 1901.

Lecithaster gibbosus (Rudolphi), OEHNER, Die Trematoden des arktischen Gebietes, Fauna Arctica, vol. 4, pp. 356-359, 1905.—Looss, Zool. Jahrb., vol. 26, pp. 164, 165, 1907.—MANTER, Illinois Biol. Mon., vol. 10, No. 2, pp. 95, 96, fig. 61, 1926.

Small distomes belonging to the genus *Lecithaster*, which agree closely with this species, are recorded.

Hosts.—Siversides (*Menidia notata*), common scup (*Stenotomus chrysops*).

Record of collections.—From siversides: *Distomum* sp. recorded from this host (Bull. U. S. Fish Comm. for 1899, p. 444, figs. 357, 358, 1901) probably belong here. Small distomes, collected August 11, 1919, noted while examining young siversides for their food. One to nine found in each of six fishes, measuring 25 to 85 mm. in length.

Dimensions of one, life: Length 1.05 mm., breadth 0.3 mm.; diameter of oral sucker 0.09 mm., pharynx 0.045 mm., ventral sucker 0.18 mm.; ova 0.027 by 0.015 mm. One, collected August 19, 1919; dimensions in balsam: Length 1 mm., breadth 0.21 mm.; diameter of oral sucker 0.1 mm., pharynx 0.056 mm., ventral sucker 0.15 mm.; ova 0.027 by 0.015 mm. The anatomy is indistinctly shown on account of the uterus, which, crowded with ova, fills the greater part of the body; lobes of vitellaria pyriform.

From common scup: Two (U.S.N.M. No. 8364), collected July 27, 1920. Measurements in balsam: (1) Length 1.26 mm., breadth 0.51 mm.; oral sucker, length 0.1 mm., breadth 0.15 mm.; pharynx, length 0.05 mm., breadth 0.06 mm.; diameter of ventral sucker 0.28 mm. (2) Length 1.09 mm., breadth 0.47 mm.; oral sucker, length 0.1 mm., breadth 0.13 mm.; diameter of ventral sucker 0.22 mm.; ova 0.032 by 0.018 mm.

The genitalia are obscured and more or less displaced by the accumulation of ova. The intestinal rami extend to the posterior end, the cells in their walls distinct; genital aperture ventral to pharynx; genital sinus short; cirrus pouch in front of ventral sucker, inclosing prostate and seminal vesicle; testes a short distance behind ventral sucker, nearly transverse. Ovary not distinctly seen; in one specimen it appeared to be behind the right testis, in the other behind the left. The lobes of the vitellaria are long and fingerlike.

The largest ova noted were about 0.036 by 0.018 mm.; the smallest 0.024 by 0.015 mm.

Genus APONURUS Looss, 1907

APONURUS species

PLATE 12, FIGURE 127

Four small distomes from a specimen of *Lobotes surinamensis*, September 1, 1910, are here recorded.

The distomes were somewhat macerated, and the anatomy is imperfectly shown in the mounted specimens. So far as the anatomy can be made out these distomes appear to be near the species *Aponurus laguncula* Looss (Zool. Anz., vol. 31, p. 608; Zool. Jahrb., vol. 26, p. 169, figs. 53, 54, 77, 78, 1907).

Body smooth, not differing much in breadth, bluntly rounded posteriorly, slightly tapering anteriorly; ventral sucker much larger than oral; genital pore ventral to pharynx; cirrus pouch short; prostate and seminal vesicle at anterior margin of ventral sucker; testes a short distance back of ventral sucker; ovary behind testes, about middle of post-acetabular region; vitellaria of several distinct

lobes at posterior border of ovary. The lobes of the vitellaria appeared to be distinct from each other, but were closely crowded together. Their exact number could not be determined, but there appeared to be about six of them. The uterus, filled with small ova, occupies most of the postacetabular region. The ova in three of the mounted specimens agree in size, the maximum dimensions being about 0.024 by 0.012 mm. to 0.030 by 0.016 mm. In one of the specimens the ova are smaller and somewhat irregular in shape, as if defective, maximum about 0.015 by 0.010 mm.

Measurements, life: Length, 1.36 mm.; breadth, 0.40 mm.; diameter oral sucker, 0.10 mm., pharynx, 0.06 mm., ventral sucker, 0.20 mm.; ova, 0.034 by 0.017 mm.

Measurements in balsam: Length, 1.12 mm.; breadth, 0.25 mm.; diameter oral sucker, 0.09 mm., pharynx, 0.054 mm., ventral sucker, 0.16 mm.; ova, 0.030 by 0.016 mm. (U.S.N.M. No. 8365.)

Subfamily DINURINAE Looss, 1907

Genus DINURUS Looss, 1907

DINURUS PINGUIS, new species

PLATE 9; PLATE 10, FIGURES 97-100

Distomum grandiporum Rudolphi, LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 520, 521, pl. 44, fig. 9 (from *Anguilla rostrata*), 1898.

Distomum rufoviride Rudolphi, *ibid.*, pp. 512-517, pl. 42, fig. 14, pl. 43, figs. 1-4 (from *Roccus lineatus*), 1898.

Distomum tornatum Rudolphi, LINTON, Bull. U. S. Fish Comm. for 1899, p. 442 (from *Fundulus heteroclitus*), p. 444, fig. 310 (from *Menidia notata*), p. 455 (from *Roccus lineatus*), 1901; Bull. U. S. Bur. Fish., vol. 24, p. 355 (from *Synodus foetens*), p. 356 (from *Tylosurus marinus*), p. 399, fig. 156 (from *Menticirrhus americanus*), 1905.

The genus *Dinurus* was established by Looss in 1907 with *D. tornatus* (Rudolphi) as the type species (Zool. Jahrb., vol. 26, p. 112, 1907).

The following description of the species is based on material from *Menidia notata*. Further details are given under the record of collections.

Body smooth, plump, more or less fusiform; suckers near together, the ventral much larger than the oral; pharynx nearly spherical; prepharynx and esophagus none; intestinal rami extend to posterior end of appendix. Genital aperture median at posterior ventral margin of pharynx; cirrus and cirrus-pouch short; ejaculatory duct long, sinuous; surrounded by cells of prostate gland; seminal vesicle behind ventral sucker, capacious, extending between

the testes to a point a little in advance of the middle of the posterior testis. The two testes are placed a little diagonally a short distance behind the ventral sucker, round to subtriangular in outline, the right testis a little in advance of the left. The ovary lies behind the testes, is oval-elliptical in outline, its longer diameter transverse. At its posterior border is the seminal receptacle, which is usually spacious. The shell gland is situated behind the left ventral border of the ovary to the left of the seminal receptacle. The vitellaria tubular. There' appear to be about three on each side. Anteriorly they extend to about the level of the left testis and the posterior border of the right testis, posteriorly they extend some distance back of the ovary. The folds of the uterus in adult individuals are voluminous, filling the dorsal region of the body from the ovary to the ventral sucker, and behind the ovary to the appendix into which they may press for a short distance. The accumulated ova may crowd the testes forward to the level of the ventral sucker. The excretory vessels are lateral from the ovary to the dorsal side of the pharynx, where they unite. The lateral vessels at their posterior ends unite on the dorsal side of the ovary and continue as a single vessel to the posterior end.

Measurements of a specimen from *Menidia notata*, in balsam: Length, 5 mm.; breadth at level of oral sucker, 0.35 mm., at ventral sucker, 0.80 mm.; maximum breadth, at about middle of length, 1.40 mm., near posterior end, 0.35 mm.; diameter of oral sucker, 0.21 mm., of pharynx, 0.14 mm., of ventral sucker, 0.46 mm.; right testis, length, 0.44 mm., breadth, 0.44 mm.; left testis, length, 0.52 mm., breadth, 0.39 mm.; ovary, length, 0.35 mm., breadth, 0.52 mm.; ova, about 0.018 by 0.012 mm.

Hosts.—American eel (*Anguilla rostrata*), squeteague (*Cynoscion regalis*), sea raven (*Hemitripterus americanus*), silver hake (*Merluccius bilinearis*), silversides (*Menidia notata*), kingfish (*Menticirrhus saxatilis*), toadfish (*Opsanus tau*), summer flounder (*Paralichthys dentatus*), common gurnard (*Merulinus carolinus*), northern barracuda (*Sphyræna borealis*), lizardfish (*Synodus foetens*).

Record of collections.—From American eel: One, collected August 30, 1910; length, 7 mm.; breadth, 2 mm.; fusiform. One (U.S.N.M. No. 8366), collected November 7, 1911; length, in formalin, 6 mm. Four, collected November 21, 1912; 2.5 to 6.5 mm.

Some of the following notes were made on a collection of nine distomes, measuring from 5 to 10 mm. in formalin, from the stomach of an eel taken in Chesapeake Bay, October 31, 1921.

The body in general is fusiform, although presenting a variety of shapes due to different degrees of contraction. Sagittal sections show

that the seminal vesicle extends diagonally between the testes from near the ventral to near the dorsal surface. It may be displaced in individuals which are gorged with ova so as to lie on the left side of the ventral sucker. The testes are nearly opposite each other on either side of the seminal vesicle. Sections show them to be slightly lobed. In younger specimens the testes may lie behind the ventral sucker at a distance equal to twice the diameter of the ventral sucker; in older specimens they may be crowded by the ova to either side of the ventral sucker. The ovary is relatively large, median, immediately behind the testes, extending farther ventrally than the testes. The shell gland is at the ventral edge of the ovary. Behind the ovary is the relatively large seminal receptacle. While the laterally placed vitellaria are tubular, in one series of frontal sections, in addition to the tubular vitellaria there is a vitelline mass on the left side 0.56 mm. in length and breadth and 0.65 mm. in dorsoventral diameter. In this specimen the ovary and testes are at the posterior border of the ventral sucker. The posterior end of the seminal vesicle is dorsal to the ovary and is crowded by the voluminous uterus to the left side of the ventral sucker. In a specimen with relatively few ova the distance from the ventral sucker to each testis and to the seminal vesicle is 0.77 mm., to the ovary, 0.91 mm., to the seminal receptacle, 1.18 mm. In a specimen with very many ova the distance from the ventral sucker to the left testis is 0.14 mm., to the seminal receptacle 0.42 mm.; the ovary, right testis, and seminal vesicle are contiguous to the posterior border of the ventral sucker. Estimates made from series of cross sections: (1) In a series, in which the ova had not become crowded in the postacetabular region, the distance from the ventral sucker to the seminal vesicle was 0.56 mm., and to the first testis 1 mm. (2) In a series in which the postacetabular region was crowded with ova the anterior border of the first testis was 0.05 mm., and the anterior end of the seminal vesicle was 0.18 mm. in front of the posterior edge of the ventral sucker. In a series of sagittal sections the ovary is 0.28 mm. in length and 0.42 mm. in dorsoventral diameter, the seminal vesicle 0.77 mm. in length, the seminal receptacle 0.28 mm. in length and 0.70 mm. in dorsoventral diameter.

Measurements in balsam: Length, 5.5 mm.; breadth, 1.75 mm.; diameter of oral sucker, 0.28 mm., of pharynx, 0.16 mm., of ventral sucker, 0.54 mm.; distance between oral and ventral suckers, 0.24 mm.; ova about 0.017 by 0.011 mm.

From squeteague: One, collected July 15, 1905, immature, encysted in stomach wall of host; plump, fusiform, pinkish in color, and surrounded by black pigment; only intestine, excretory vessels, and retracted appendix could be distinguished: Length, 4.5 mm.; probably belongs to this species.

From sea raven: One, collected October 11, 1911. Measurements in balsam: Oral sucker, length, 0.22 mm.; breadth, 0.25 mm.; pharynx, length, 0.14 mm., breadth, 0.18 mm.; ventral sucker, length, 0.63 mm., breadth, 0.70 mm. Specimen contracted, intestines in dense coils at posterior end; anatomy obscured by masses of ova.

From silver hake: One, collected October 31, 1911. In formalin, body plump, nearly cylindrical; neck short, subcylindrical, curved ventrad, concealing the ventral sucker; length, 4 mm.; diameter, 2 mm. Measurements in balsam, appendix retracted: Length, 3.36 mm.; breadth, 1.54 mm.; diameter of oral sucker, 0.28 mm., of pharynx, 0.22 mm., of ventral sucker, 0.70 mm.; ova, 0.015 by 0.012 mm.

From silversides: Few, collected August 25, 1906. Three, collected August 10, 1910. One, collected August 11, 1910. Measurements, life, compressed: Length, 5.36 mm.; breadth, 1.82 mm.; diameter of oral sucker, 0.25 mm., of pharynx, 0.18 mm., of ventral sucker, 0.61 mm.; ova, 0.018 by 0.012 mm.; folds of uterus voluminous. Two (U.S.N.M. No. 8367), collected July 30, 1929.

From kingfish: One (U.S.N.M. No. 8368), collected August 28, 1928. Thirty-four fishes, from 75 to 123 mm. in length, examined. Length, in balsam, 8 mm.; maximum breadth, 2 mm. from anterior end, 1.82 mm., tapering to about 0.28 mm. near each end; diameter of oral sucker, 0.18 mm., of pharynx, 0.14 mm., of ventral sucker, 0.49 mm.; distance from anterior end to ventral sucker, 0.42 mm.; ova about 0.015 by 0.012 mm., much crowded and difficult to measure.

From toadfish: Three, collected August 15, 1899. Flesh color, except where the ova impart a yellowish tinge and the vitellaria a brownish color; plump, and of exceeding diversity of shape; posterior end with concentric wrinkles, often button-shaped. Body cylindrical, neck conical and very extensible. In some cases the neck and ventral sucker would be on a slender stalk, and the greater part of the body gathered into a globular mass at the posterior end. Then, in a few seconds, the worm would become nearly spherical. Length of one at rest, 5 mm., diameter, 1.7 mm. In a series of sagittal sections the length is about 5 mm. and the diameter 1.5 mm.; the largest cross sections measure 1.29 mm. in vertical and 1.23 mm. in transverse diameter; oral sucker, length, 0.24 mm., diameter, 0.19 mm.; diameter of pharynx, 0.15 mm., of ventral sucker, 0.49 mm.; ova, 0.018 by 0.012 mm.

From summer flounder: Three, collected October 1, 1903. Lengths in formalin, 2.5 mm., 3 mm., and 3.5 mm.; diameter of neck, 0.7 mm., of body, 1.5 mm.; ova, 0.018 by 0.012 mm.

One (U.S.N.M. No. 8369), collected September 23, 1912. Length, 6 mm. in formalin.

From common gurnard: A distome, collected August 21, 1911, by Dr. G. A. MacCallum, belongs here.

From northern barracuda: One (U.S.N.M. No. 8370), collected August 31, 1903; four fishes examined. Measurements in balsam, appendix retracted: Length, 3.36 mm.; breadth, 1 mm.; oral sucker, length, 0.18 mm., breadth, 0.23 mm.; pharynx, length, 0.13 mm., breadth, 0.14 mm.; diameter of ventral sucker, 0.48 mm.; ova, 0.018 by 0.012 mm. Testes about equal, diameter 0.54 mm.; ovary, length 0.35 mm., breadth 0.43 mm.; seminal vesicle, length 0.56 mm., breadth, 0.33 mm.

From lizardfish: Three (U.S.N.M. No. 8371), collected September 10, 1928; fifteen fish, 75 to 125 mm. in length, examined; fish seined at Wareham.

TABLE 33.—Measurements of three specimens of *Dinurus pinguis* in balsam

| Measurement | 1 ¹ | 2 | 3 |
|------------------------------|----------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 3.15 | 5.43 | 6.86 |
| Breadth..... | 1.18 | 1.93 | 1.93 |
| Oral sucker, length..... | .17 | .21 | .24 |
| Oral sucker, breadth..... | .21 | .21 | .36 |
| Pharynx, length..... | .13 | .14 | .21 |
| Pharynx, breadth..... | .13 | .14 | .20 |
| Ventral sucker, length..... | .42 | .63 | .70 |
| Ventral sucker, breadth..... | .42 | .56 | .63 |

¹ No. 1, ventral view; Nos. 2 and 3, lateral view.

Ova crowded, collapsed, about 0.018 by 0.009 mm.

DINURUS TORNATUS (Rudolphi)

Distomum tornatum Rudolphi, LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 513, 514, pl. 42, figs. 6-12 (from *Coryphacna hippurus*), 1898; Bull. U. S. Fish Comm. for 1899, p. 452, 1901; Bull. U. S. Bur. Fisheries, vol. 24, p. 373 (from *C. hippurus*), p. 374 (from *C. equisetis*), 1905.

The posterior end of a distome (U.S.N.M. No. 8372) that had been broken just behind the ventral sucker was obtained from a harvest-fish (*Peprilus paru*) on July 24, 1908. The fragment was active, anterior portion serrate; intestines and uterus extending nearly to posterior end of appendix. Seminal vesicle large, diagonal, its posterior end near anterior border of first testis; testes diagonal, touching each other, first testis triangular in outline, second elliptical, length of each 0.32 mm., breadth, 0.21 mm.; ovary a short distance behind testes, length, 0.25 mm., breadth, 0.32 mm.; body of nearly uniform diameter, 0.7 to 0.8 mm.; appendix, diameter at anterior end, 0.7 mm., tapering uniformly to posterior end. From anterior end of fragment to seminal vesicle 0.4 mm., to first testis, 0.7 mm., to ovary,

1.4 mm. One of the tubular vitellaria extends about 0.5 mm. into the appendix, and the folds of the uterus reach to within 0.6 mm. of the posterior end; ova, 0.013 by 0.009 mm. All measurements made on specimen mounted in balsam.

A fragment, from harvestfish, collected August 7, 1908: Posterior end, containing the ovary, vitellaria and folds of the uterus crowded with ova. Length, 2.10 mm.; diameter, 0.77 mm.; ova, 0.015 by 0.009 mm. Two larval dibothria had penetrated the fragment, length of each 1.20 mm., breadth, 0.19 mm.

Genus ECTENURUS Looss, 1907

ECTENURUS VIRGULA Linton

PLATE 8, FIGURE 78

Ectenurus virgula LINTON, Carnegie Inst. Washington Publ. 133, pp. 63, 64, fig. 148 (from *Clupanodon pseudohispanicus*, Tortugas, Fla.), 1910.

A distome (U.S.N.M. No. 8373), collected August 17, 1913, from *Trachurops crumenophthalma*, is in close agreement with distomes from the Spanish sardine, collected at the Dry Tortugas. The nuchal eminence, which characterizes Looss's genus *Ectenurus*, cannot be distinguished, but neither can it be seen in some of the Tortugas specimens.

The body is transversely striate with sharply and rather coarsely serrate margins. The diameter of the ventral sucker is about three times that of the oral; pharynx subglobular. The neck is much contracted, and the appendix is retracted. The genital aperture is at the ventral margin of the oral sucker; cirrus pouch slender; seminal vesicle divided into three compartments, one following the other, and increasing slightly in size posteriorly, dorsal and posterior to ventral sucker. The two testes lie near the posterior border of the ventral sucker and are diagonally placed. The right testis is close to the border of the sucker, and the left is contiguous to the posteroventral surface of the posterior division of the seminal vesicle. The ovary is larger than the testes and is contiguous to the posterior border of the left testis. Length of first testis, 0.08 mm., breadth, 0.12 mm.; length of second testis, 0.08 mm., breadth, 0.15 mm.; length of ovary, 0.15 mm., breadth, 0.19 mm. Vitellaria tubular, on right, left, and posterior sides of the ovary. The folds of the uterus are mainly behind the ovary and vitellaria, filling the space between the vitellaria and the base of the appendix. The ova are small, collapsed, and crowded, and difficult to measure; about 0.016 by 0.008 mm.

Measurements in balsam: Length, 1.4 mm.; breadth, 0.43 mm.; diameter of oral sucker, 0.11 mm., of pharynx, 0.07 mm., of ventral sucker, 0.30 mm.

Genus LECITHOCLADIUM Lühe, 1901

LECITHOCLADIUM GULOSUM (Linton)

PLATE 8, FIGURES 79-82

Distomum gulosum LINTON, Bull. U. S. Fish Comm. for 1899, p. 454, figs. 315-317, 1901.—NICOLL, Ann. Mag. Nat. Hist., ser. 7, vol. 19, p. 69, 1907.

Lecithocladium gulosum (Linton), Looss, Zool. Jahrb., vol. 26, p. 135, 1907.

One specimen from the chub mackerel was observed to have a distinct hump on the neck, thus resembling *L. cristatum* (Rudolphi), but this nuchal hump may be due to contraction, since it is absent from others which are mounted in a position to show the neck in lateral view. There is no indication of the incised serrations characteristic of *L. excisum* (Rudolphi).

TABLE 34.—Measurements of the seminal vesicle of *Lecithocladium gulosum* in two series of cross sections and four series of sagittal sections

| Measurements | Cross | | Sagittal | | | |
|--------------------------------|-------|------|----------|------|------|------|
| | Mm. | Mm. | Mm. | Mm. | Mm. | Mm. |
| Length..... | 0.42 | 0.49 | 0.46 | 0.52 | 0.53 | 0.64 |
| Maximum diameter..... | .32 | .24 | .29 | .28 | .17 | .20 |
| Maximum thickness of wall..... | .10 | .08 | .08 | .06 | .05 | .02 |

TABLE 35.—Measurements of specimens of *Lecithocladium gulosum* in balsam

| Measurements | From <i>Poronotus</i> <i>triacanthus</i> | | From <i>Pneumatophorus</i> <i>grew</i> | | From <i>Scomber</i> <i>scombrus</i> | |
|-------------------------------|--|------|--|------|---|------|
| | Mm. | Mm. | Mm. | Mm. | Mm. | Mm. |
| Length..... | 8.40 | 8.82 | 7.42 | 9.42 | 6.58 | 6.02 |
| Breadth..... | 1.14 | 1.16 | .94 | 1.12 | .70 | .55 |
| Oral sucker, length..... | .46 | .51 | .46 | .56 | .42 | .45 |
| Oral sucker, breadth..... | .42 | .36 | .39 | .52 | .25 | .33 |
| Pharynx, length..... | .42 | .38 | .45 | .49 | .42 | .45 |
| Pharynx, breadth..... | .18 | .19 | .25 | .22 | .17 | .17 |
| Ventral sucker, length..... | .40 | .42 | .39 | .43 | .35 | .34 |
| Ventral sucker, breadth..... | .38 | .36 | .39 | .43 | .35 | .34 |
| Seminal vesicle, length..... | .77 | .77 | .77 | 1.09 | .56 | .53 |
| Seminal vesicle, breadth..... | .25 | .25 | .21 | .31 | .18 | .17 |

The ova in all the balsam mounts are crowded and collapsed, about 0.018 by 0.009 mm. Average of 10 specimens from *P. triacanthus*: Length of oral sucker, 0.32 mm.; of pharynx, 0.29 mm.; of ventral sucker, 0.30 mm. Average of 10 from *P. grew*: Length of oral sucker, 0.28 mm.; of pharynx, 0.29 mm.; of ventral sucker, 0.23 mm.

Hosts.—Dollarfish (*Poronotus triacanthus*), chub mackerel (*Pneumatophorus grew*), common mackerel (*Scomber scombrus*).

Record of collections.—From dollarfish: Three, collected July 24, 1918. Two (U.S.N.M. No. 8374), collected July 25, 1918.

From chub mackerel: One, collected August 15, 1918, fragment, suckers missing. Excretory vessel, dark brown, slender, extends from posterior end to anterior edge of testes, where it divides into two lateral vessels; length, 5 mm.

Twelve, collected August 19, 1918. Some of these are fragments as on previous date. The suckers adhere to the mucous membrane of the host and the worms have a tendency to break behind the ventral sucker unless care is taken in removing them. Measurements, life: Length, 6 mm.; oral sucker, length, 0.48 mm., breadth, 0.38 mm.; pharynx, length, 0.42 mm., breadth, 0.20 mm.; diameter of ventral sucker, 0.42 mm. Length very variable, depending on the degree of contraction.

Fifteen and several fragments, collected August 31, —; very extensible, some of them stretching to a length of 15 mm. or more.

Collection of August 22, 1910. Number not noted. Color of body reddish, neck translucent-white, entire. Length as much as 6 mm. Measurements, life: Length, 5.36 mm.; breadth, 0.87 mm.; oral sucker, length, 0.58 mm.; breadth, anterior, 0.56 mm., posterior, 0.21 mm.; pharynx, length 0.56 mm., breadth, anterior, 0.21 mm., posterior, 0.25 mm.; ventral sucker, length, 0.49 mm., breadth, 0.54 mm.; ova, 0.02 by 0.01 mm.

Seventeen, collected August 18, 1920; various contraction forms, with tendency to be somewhat swollen toward the posterior end when the appendix is retracted. Seven (U.S.N.M. No. 8375), collected July 21, 1928; actively contracting and extending, from 4 to 9 mm.

Five, collected August 6, 1928; 3 to 7 mm., translucent, reddish yellow in region of uterus. One (U.S.N.M. No. 8376), collected August 23, 1928. Six, collected July 6, 1929; 3 fishes examined. Thirty-two, collected July 11, 1929; 3 fishes examined. Four, collected July 29, 1929; 3 fishes examined. Twenty-eight, collected August 19, 1929; 3 fishes examined.

From common mackerel: Two (U.S.N.M. No. 8377), collected August 10, 1906. Measurements, life: Length, 7 mm.; diameter, anterior, 0.37 mm., middle, 0.84 mm., thence tapering to 0.28 mm. or less at the posterior end; oral sucker, length, 0.49 mm., breadth, 0.28 mm.; pharynx, length, 0.42 mm., breadth, 0.16 mm.; diameter of ventral sucker, 0.35 mm.; ova, 0.02 by 0.01 mm.

CYST CONTAINING TREMATODE OVA

PLATE 11, FIGURE 108

A cyst from the wall of the postbranchial chamber of a summer flounder (*Paralichthys dentatus*), collected by Dr. C. W. Hahn, July

25, 1910, contains coils of the uterus of a distome. The specimen in balsam measures: Length, 3.57 mm.; maximum breadth, about 1 mm.; ova, 0.024 by 0.012 mm. Portions of the uterus are filled with ova, while other portions contain yellow, granular material, presumably yolk granules. In some places this material is associated with ova. The size of this fragment suggests a distome of the dimensions of *Dinurus pinguis*, but the ova are distinctly larger than they are in that species. (U.S.N.M. No. 8378.)

Family ACCACOELIIDAE Odhner, 1928

Distomes from the pelagic sunfish, *Mola mola*, are here considered.

These are medium to large distomes with elongated and strongly muscular bodies, in most cases smooth; neck short and often more or less reflected dorsally; ventral sucker larger than oral, often pedicelled, thus causing the anterior end of the worm to appear to be forked. Pharynx much smaller than oral sucker, usually long-pyri-form; esophagus long, intestinal rami elongate with anterior diverticula, giving to the intestine the characteristic H-shape. Excretory vessel Y-form with short stem and short branches; genital pore ventral, median, behind oral sucker; copulatory organ muscular; ejaculatory duct surrounded by prostatic cells; seminal vesicle tubular, convoluted, usually entirely in front of ventral sucker, or dorsal to it. Testes behind ventral sucker, close together, one following the other. Ovary behind testes, median; shell gland at anterior edge of ovary; no seminal receptacle, the sperm being stored in the early folds of the uterus; vitellaria lateral variously distributed in the different species; uterus voluminous, mainly behind the ovary; metratrum with muscular walls, ventral to seminal vesicle and prostate; ova numerous, small. The relative positions of structures, especially at the anterior end, are subject to considerable alteration with varying contraction conditions.

The classification adopted by Odhner¹⁴ has been followed:

Genus ACCACOELIUM Monticelli, 1893

ACCACOELIUM CONTORTUM (Rudolphi)

Distomum contortum (Rudolphi), LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 528-530, pl. 48, figs. 3-7, 1898; Bull. U. S. Fish Comm. for 1899, p. 466, 1901.—SUMNER, OSBURN, and COLE, Bull. U. S. Bur. Fisheries, vol. 31, pt. 2, p. 582, 1911.

Accacoelium contortum (Rudolphi), ODHNER, Zool. Anz., vol. 77, p. 172, 1928.

Anterior part of body covered with blunt, papillalike spines; prepharynx protrudes into oral sucker, forming a conical papilla; geni-

¹⁴ *Rhynchopharynx paradoxa* n. g., n. sp. nebst Revision der Accacoeliden von *Orthogoriscus mola*. Zool. Anz., vol. 66, pp. 167-175, 1928.

tal pore at level of posterior edge of oral sucker; copulatory organ large; ejaculatory duct convoluted, surrounded by prostatic cells; convoluted seminal vesicle, dorsal to ventral sucker; first testis some distance behind ventral sucker; vitellaria mainly behind ovary.

Measurements made on a series of sagittal sections: Length, 10.00 mm.; maximum breadth, 1.60 mm.; oral sucker, length, 0.70 mm., breadth, 0.91 mm.; pharynx, length, 0.42 mm., breadth, 0.21 mm.; ventral sucker, length, 1.19 mm., breadth, 1.40 mm.; anterior end to posterior edge of ventral sucker, 3.78 mm.; anterior end to first testis, 5.18 mm.; second testis to ovary, 0.56 mm.; ova, maximum, about 0.033 by 0.021 mm.

TABLE 36.—*Measurements of four specimens of Accacoelium contortum in balsam.*

| Measurement | 1 | 2 | 3 | 4 |
|---|------------|------------|------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 14.00 | 15.00 | 14.00 | 15.00 |
| Maximum breadth..... | 1.00 | 2.00 | 1.50 | 1.00 |
| Oral sucker, length..... | .50 | .70 | .56 | .56 |
| Oral sucker, breadth..... | .38 | .62 | .56 | .50 |
| Pharynx, length..... | .28 | .42 | .35 | .28 |
| Pharynx, breadth..... | .14 | .16 | .16 | .14 |
| Ventral sucker, length..... | .63 | 1.12 | .70 | .77 |
| Ventral sucker, breadth..... | .70 | .91 | .84 | .56 |
| Length of ventral sucker and pedicel..... | 1.68 | 1.05 | 1.33 | 2.10 |

Host.—Ocean sunfish (*Mola mola*).

Record of collections.—A collection (U.S.N.M. No. 8379), of July 20, 1914. Number not recorded in notes. Heads and necks inserted in mucous membrane of pharynx; body slender, cylindrical, tapering to posterior end, yellowish. These worms were still active after lying in sea water over night.

Twenty-five (U.S.N.M. No. 8380), collected September 3, 1925, in one mass in pharynx of host. These distomes were found by Dr. G. A. MacCallum while examining the gills of a sunfish.

Twenty-five, collected July 19, 1926, in anterior portion of alimentary canal, and on gills.

Genus ACCACLADOCOELIUM Odhner, 1928

ACCACLADOCOELIUM MACROCOTYLE (Diesing)

Distomum macrocotyle Diesing, LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 522, 523, pl. 45, figs. 8–10, pl. 46, figs. 1–5, 1898; Bull. U. S. Fish Comm. for 1899, p. 282, 1900; *ibid.*, p. 466, 1901.—SUMNER, OSBURN, and COLE, Bull. U. S. Bur. Fish., vol. 31, pt. 2, p. 583 1911.

Accacladocoelium macrocotyle (Diesing), ODHNER, Zool. Anz., vol. 77, p. 172 1928.

Smooth; genital pore at posterior edge of oral sucker; copulatory organ short, ejaculatory duct not much convoluted; prostate large; convoluted seminal vesicle at anterior dorsal border of ventral sucker; first testis usually near ventral sucker; vitellaria extend from oral sucker to ovary; ova about 0.024 by 0.018 mm.

Measurements, balsam, lateral view: Length, 13.00 mm.; maximum breadth, 1.54 mm.; oral sucker, length, 0.61 mm., breadth, 0.56 mm.; ventral sucker, length, 1.33 mm., breadth, 1.30 mm.; anterior end to posterior border of ventral sucker, 3.24 mm.; anterior end to first testis, 3.15 mm.; second testis to ovary, 0.21 mm.; ovary to posterior end, 6.30 mm.

Measurements made on a series of sagittal sections: Length, 10.00 mm.; maximum breadth, 1.26 mm.; oral sucker, length, 0.50 mm., breadth, 0.50 mm.; pharynx, length, 0.30 mm., breadth, anterior, 0.08 mm., breadth, posterior, 0.15 mm.; ventral sucker, length, 1.20 mm., breadth, 1 mm.; anterior end to posterior border of ventral sucker, 3.85 mm.; anterior end to first testis 3.85 mm.; second testis to ovary, 0.40 mm.; ovary to posterior end, 4.12 mm.; copulatory organ, retracted, length, 0.24 mm., breadth, 0.07 mm.

Host.—Ocean sunfish (*Mola mola*).

Record of collections.—Eleven (U.S.N.M. No. 8381), collected July 20, 1914, from intestine of host; fusiform, elongate posteriorly; translucent; intestine dark brown; uterus greenish yellow. A number of these distomes were clinging to cestodes (*Ancystrocephalus microcephalus*); maximum length, compressed under cover-glass, about 18 mm.

Fourteen (U.S.N.M. No. 8382), collected September 3, 1925, from intestine of host; 20 mm. in length, in alcohol.

Genus ACCACLADIUM Odhner, 1928

ACCACLADIUM SERPENTULUS Odhner

Distomum nigroflavum Rudolphi, LINTON, Proc. U. S. Nat. Mus., vol. 20, pp. 530, 531, pl. 48, figs. 8–11, pl. 49, figs. 1, 2, 1898; Bull. U. S. Fish Comm. for 1899, p. 282, 1900; *ibid.*, p. 406, 1901.—SUMNER, OSBURN, and COLE, Bull. U. S. Bur. Fisheries, p. 31; pt. 2, p. 583, 1911.

Accacladium serpentulus ODHNER, Zool. Anz., vol. 77, pp. 173–174, fig. 3, 1928.

Nearly smooth, but with a few minute, scattering papillae at the anterior end. There is a blunt papilla in the oral sucker at the entrance of the prepharynx. Genital pore some distance back of posterior edge of oral sucker. In a series of sagittal sections, distance between oral and ventral suckers about 2 mm.; the genital pore is about 0.5 mm. back of the oral sucker. Copulatory organ rather large; in a series of sagittal sections, length, 0.70 mm., diameter, 0.14 mm., tapering to 0.07 mm. at its anterior end. The prostate is well

developed. In a specimen mounted in balsam, copulatory organ everted, the length of the prostate is 0.70 mm., its diameter 0.14 mm., ejaculatory duct somewhat convoluted. In a series of sagittal sections, copulatory organ retracted, the length of the prostate is 0.56 mm., diameter, 0.50 mm.; ejaculatory duct much convoluted. Seminal vesicle tubular, convoluted, dorsal to and behind ventral sucker; first testis some distance back of ventral sucker; folds of uterus behind ovary and also between ventral sucker and first testis; vitellaria behind ventral sucker, extending nearly to ovary. Ova, 0.027 by 0.019 mm. to 0.03 by 0.021 mm.

Measurements, balsam, lateral view: Length, 12.00 mm., maximum diameter, 1.12 mm.; oral sucker, length, 0.70 mm., breadth, 0.63 mm.; pharynx, length, 0.35 mm., breadth, 0.14 mm.; ventral sucker, 0.91 mm., breadth, 0.63 mm.; anterior end to posterior border of ventral sucker, 2.38 mm.; anterior end to first testis, 3.36 mm.; second testis to ovary, 0.28 mm.; ovary to posterior end, 4.42 mm.

Host.—Ocean sunfish (*Mola mola*).

Record of collections.—Eleven (U.S.N.M. No. 8383), collected July 20, 1914, from intestine of host.

One, collected September 3, 1925, from intestine of host. Length of neck, 4 mm., length of body back of ventral sucker, 40 mm.; length of ventral sucker and pedicel, 3 mm.

Several, collected July 19, 1926, found in intestine of host; number not recorded.

Thirteen, collected July 13, 1927, in intestine of host.

Genus OROPHOCOTYLE Looss, 1902

OROPHOCOTYLE FOLIATA (Linton)

Distomum foliatum Linton, Proc. U. S. Nat. Mus., vol. 20, pp. 532-534, pl. 50, figs. 1-3; pl. 51, figs. 1-4, 1898; Bull. U. S. Fish Comm. for 1899, p. 282, 1900; *ibid*; p. 466, 1901.—SUMNER, OSBURN, and COLE, Bull. U. S. Bur. Fish., vol. 31, pt. 2, p. 583, 1911.

Orophocotyle foliata (Linton), Looss, Centralbl. Bakt., Parasit., vol. 31, p. 644, 1902.—ODHNER, Zool. Anz., vol. 77, p. 175, 1928.

Odhner¹⁵ is of the opinion that Monticelli's *Distomum calyptrocotyle* is the immature form of *D. foliatum*.

Smooth; ventral sucker with accessory lobes, often pedicelled, much larger than oral; genital pore a short distance behind oral sucker; copulatory organ short; ejaculatory duct rather short, convoluted; prostate not large; convoluted seminal vesicle in front of ventral sucker, some of its folds dorsal to prostatic portion of ejaculatory duct. First testis, in some cases near, even on a level

¹⁵ Zool. Anz., vol. 38, p. 525, 1911; vol. 77, p. 175, 1928.

with the ventral sucker, in others at a considerable distance behind the ventral sucker, with numerous folds of the uterus between testis and ventral sucker; vitellaria in neck and extending from the oral sucker to the testes, vitelline ducts continuing to the shell gland. Ova, maximum in balsam, 0.030 by 0.018 mm. to 0.033 by 0.021 mm.

TABLE 37.—Measurements of five specimens of *Orophocotyle foliata*

| Measurement | 1 ¹ | 2 ¹ | 3 ¹ | 4 ¹ | 5 ¹ |
|--|----------------|----------------|----------------|----------------|----------------|
| | Mm. | Mm. | Mm. | Mm. | Mm. |
| Length..... | 15.00 | 16.00 | 14.00 | ----- | ----- |
| Maximum breadth..... | .84 | 1.12 | .77 | ----- | ----- |
| Oral sucker, length..... | .53 | .67 | .72 | 0.52 | 0.63 |
| Oral sucker, breadth..... | .49 | .74 | .35 | .21 | .39 |
| Pharynx, length..... | .28 | .44 | .42 | .30 | .42 |
| Pharynx, breadth..... | .16 | .21 | .16 | .15 | .23 |
| Ventral sucker, length..... | 1.33 | 1.40 | 1.33 | ----- | ----- |
| Ventral sucker, breadth..... | .70 | .70 | 1.50 | ----- | ----- |
| Length ventral sucker and pedicel..... | 1.96 | 1.12 | 2.10 | ----- | ----- |

¹ In balsam.² Sagittal sections.

Host.—Ocean sunfish (*Mola mola*).

Record of collections.—Several (U.S.N.M. No. 8384), collected July 20, 1914, from intestine of host.

Eight (U.S.N.M. No. 8385), collected September 3, 1925, from intestine of host; lengths 8 to 22 mm.

Twenty-seven, collected July 19, 1926, from intestine of host.

Family DIDYMOZOONIDAE Monticelli, 1888

Genus DIDYMOZOON Taschenberg, 1878

DIDYMOZOON SCOMBRI Taschenberg

PLATE 23, FIGURES 305-309

*Didymozoon scombr*i Taschenberg, ODHNER, Surtrych ur "Zoologische Studien" tillagnade T. Tullberg, pp. 311-323, text figs. 1, 2, pl. figs. 1-11, 1907.

A tangled mass of trematodes (U.S.N.M. No. 8386), found in the intestinal wall of a butterfish (*Poronotus triacanthus*), July 24, 1918, was straightened out on a slide and fixed under slight pressure. The entire lot consists of seven individuals, aggregate length in alcohol 264 mm. Length of one of the longest specimens in balsam, 40 mm.; breadth near oral sucker, 0.53 mm., elsewhere from 0.18 to 0.52 mm.; oral sucker, length, 0.23 mm., breadth, 0.21 mm. In another, diameter of oral sucker, 0.29 mm.; breadth near oral sucker, 0.63 mm., for the first 2 mm. of the length; elsewhere the breadth varies from 0.28 to 0.35 mm.; rami of the intestines could be traced for a short distance but were soon hidden by the uterus. In one specimen, approximately 40 mm. in length, the anterior end of the

first testis was about 1.6 mm. from the anterior end. The tubular ovary began near the testes and continued in the germ duct which ended at the shell gland, about 15 mm. from the anterior end. The tubular vitelline gland extended from the shell gland to the posterior end. The uterus, lying mainly in two longitudinal folds, fills the body in most cases from near the oral sucker to the posterior end. The uterus and ejaculatory duct appeared to open at the posterior margin of the oral sucker in one; while in another the uterus can be traced to the right anterior ventral margin of the oral sucker, thence it appears to cross over to the left anterior border. In another the uterus opens at the ventral edge of the oral sucker a little to the left of the median line. In another the uterus opens on the median line at the anterior ventral border of the oral sucker. Where best shown the opening of the uterus is slightly prominent, as a very low rounded papilla at the ventral border of the oral sucker.

There is much variation in the testes. In general the right testis is considerably in advance of the other. Thus, in one the left testis is much smaller than the right, and its anterior end is about on a level with the posterior end of the right testis. Each is elongated and more or less convolute-lobed. In another the relative positions are about the same but the second, or left, testis is larger than the first. In another the testes are nearly opposite, as figured by Odhner. In another they are opposite and very much reduced in size. In this specimen the uterus exhibits regional inflations as in Odhner's figure (l. c., fig. 8).

DIDYMOZOON SARDAE (G. A. and W. G. MacCallum)

PLATE 23, FIGURE 310

Koellikeria sardae G. A. and W. G. MACCALLUM, Zool. Jahrb., vol. 39, pp. 161-166, figs. 11-16, 1916.

Following is a record of collections of this trematode which were made by Mr. Edwards and myself. So far as details of the anatomy are shown in mounted material they agree with the description of the species given by the MacCallums. In one of the specimens mounted in balsam the intestine is seen to divide at about the middle of the length of the testes, or 2.8 mm. from the anterior end. The esophagus is conspicuous, being surrounded by a thick wall of cells, while the walls of the intestine are exceedingly thin.

Host.—Bonito (*Sarda sarda*).

Record of collections.—Four, collected July 7, 1903, by Vinal N. Edwards, from gills of one fish.

Measurements in formalin: Largest cyst, length, 12 mm., breadth, 3.5 mm.; smallest cyst, length, 7 mm.; breadth, 4.5 mm. Two worms from largest cyst measured 34 and 37 mm. in length, respectively;

maximum breadth, 0.9 mm.; necklike portion at anterior end, length, 6.5 mm.; breadth, 0.45 mm.; diameter at anterior end, 0.33 mm.; diameter of oral sucker, 0.26 mm.; pharynx, length, 0.21 mm., breadth, 0.15 mm.; ova, 0.014 by 0.011 mm. Worms from smallest cyst of practically the same dimensions as those from largest cyst.

Two cysts from one of three fishes examined August 18, 1903. One fish examined on August 19, two on August 20, and one on August 24; no cysts found. Length of cyst, 10 mm.; diameter, 3 mm. Two worms from each cyst, measuring 50 mm. in length in sea water. Walls of cyst transparent; color of worms yellow, due to ova in the voluminous folds of the uterus; neck translucent, bluish-white, traversed by a yellow line, the metraterm. Measurements, life: Oral sucker, length, 0.17 mm., breadth, 0.20 mm.; pharynx, length, 0.17 mm., breadth, 0.15 mm. Three cysts from gills, two worms in each cyst, collected by Vinal N. Edwards September 22, 1903.

Six cysts from gills, collected June 17, 1904, by Vinal N. Edwards; long oval-elliptical, length 10 mm., diameter, 3.5 mm.

Cysts from gills. Edwards examined the gills of 100 bonitos on August 31, 1904, and found about 10 out of every 12 infected, with 2 and 3 cysts on each infected fish.

One cyst collected July 8, 1905, from gills containing two worms, one 50 mm. in length, the other slightly less.

Gills of bonito were examined on six dates, August 10 to 27, 1906, no cysts found.

Three cysts from gills (U.S.N.M. No. 8387), two worms in each cyst, collected August 3, 1908. These were younger stages than any of those hitherto recorded. One of them was examined while it was still active. Length of esophagus about 2.5 mm.; intestinal rami extend to the posterior end, and in places contained orange-colored granular material. The anterior end of the uterus, metraterm, was nearly straight, lay beside the esophagus and opened at the junction between the oral sucker and pharynx; ova, 0.014 by 0.009 mm., yellowish, but with moderately high magnification, both by transmitted and reflected light, they appear to be faintly greenish. In another specimen, length, 18 mm., neck slender, length, 3.5 mm.; anterior end white, remainder of body lemon yellow, due to ova; rami of intestine convoluted; neck very contractile; oral sucker and pharynx each oval-elliptical in outline, and of about the same size, 0.015 to 0.016 mm. in diameter; neck very changeable, varying in diameter from 0.2 to 0.7 mm.; movements of body back of neck very slight; diameter of body from 0.8 to 1 mm., tapering to posterior end. In another specimen the pharynx was much smaller than the oral sucker and appeared to be rather thin-walled and collapsed. In this specimen the neck was contracted so as to throw the esophagus into a number of crowded

folds which would have been difficult to interpret if other specimens had not been at hand. The vas deferens was traced into the neck where it lay ventral to the esophagus and the right of the uterus.

Some small, yellowish masses, collected June 27, 1910, encysted on the viscera proved to contain trematode ova, 0.017 by 0.010 mm., associated with granular material. The ova resemble those of trematodes from the gills of the bonito.

Slender, filiform fragments collected by Dr. C. W. Hahn, July 21, 1911, under the mucous membrane of the inner wall of the gill chamber, also fragments from a cyst. These fragments are narrow and ribbonlike; ova, 0.015 by 0.009 mm.

DIDYMOZOON species

PLATE 23, FIGURES 311-314

Following are records of trematodes probably to be referred to this genus but which do not present sufficient characters to admit of specific determination.

Hosts.—Frigate mackerel (*Auxis rochei*), chub mackerel (*Pneumatophorus grex*), common mackerel (*Scomber scombrus*), rudderfish (*Seriola zonata*).

Record of collections.—Cyst on gills (U.S.N.M. No. 8388), collected July 12, 1912, from frigate mackerel; length, 4 mm.; diameter, 1.5 mm. The cyst contained portions of uterus and vitellaria; ova with rather thin shells, much crowded, about 0.018 by 0.009 mm. The specimen was doubled on itself and represented a length of about 6.65 mm., breadth, 0.63 mm.

From the chub mackerel (fig. 313): A small yellow cyst, collected August 15, 1908, in muscle tissue beside the anal aperture of the host. Three yellow cysts, collected in August, 1908, from gills of one fish, and one from another (U.S.N.M. No. 8389). These cysts contained slender trematode fragments filled with ova about 0.012 by 0.006 mm. Fragments mounted in balsam aggregate about 25 mm. in length, and vary in breadth from 0.05 to 0.26 mm. One specimen complete, length about 18 mm., breadth varying from 0.05 to 0.28 mm.; oral sucker, terminal, about 0.07 mm. in diameter; pharynx not distinct, being hidden by ova.

From common mackerel (figs. 311, 312): Two yellow, globular cysts on pyloric caeca (U.S.N.M. No. 8390), collected August 10, 1906. One cyst contained a threadlike trematode, broken into fragments which aggregated a length of about 180 mm., and, for the most part, 0.07 to 0.14 mm. in breadth; ova, 0.014 by 0.008 mm. Two heads were found. Diameter at anterior end, 0.14 mm., at 0.28 mm. from anterior end, 0.29 mm., at 1 mm. from anterior end, 0.15 mm. The second cyst contained a large number of eggs. These frag-

ments were mounted in balsam but the slide does not appear to have either of the heads.

From rudderfish (fig. 314): Twelve (U.S.N.M. No. 8391), collected September 12, 1928. Slender distomes firmly attached to the mucous membrane of the stomach; there was some inflammation at the point of attachment. Many fragments were obtained and mounted in balsam. Maximum diameter, 0.25 mm. In addition to folds of the uterus crowded with ova there are remnants of tubular vitellaria. The ova are rather elongate, more or less collapsed, from 0.024 by 0.010 to 0.027 by 0.012 mm.

Genus WEDLIA Cobbold, 1860

WEDLIA BIPARTITA (Wedl)

PLATE 23, FIGURES 315-317; PLATE 24, FIGURE 318

Wedlia bipartita (Wedl), ODLINER, "Zoologische Studien" tillagnade Prof. T. Tullberg, pp. 323-392, pl. figs. 12, 13; text figs. 3-6, 1907.—FUHRMANN, Handb. Zool., Kükenthal-Krumbach, vol. 2, pp. 64, 65, 73-75, figs. 85, 97, 1928. *Koellikeria* (*Didymozoon*) *thynni* Taschenberg, G. A. and W. G. MACCALLUM, Zool. Jahrb., vol. 39, p. 144, 1916.

For the older literature see Stiles and Hassall, Hygienic Lab. Bull. No. 37, 1908: *Didymocystis wedlei* Ariola, p. 152; *Didymozoon thynni* Taschenberg, p. 153; *Monostomum bipartitum* Wedl, p. 310; *Wedlia bipartita* (Wedl, 1844), p. 383.

Following are brief notes on encysted trematodes from the horse mackerel (*Thunnus secundodorsalis*):

Record of collections.—Thirty or more (U.S.N.M. No. 8392), collected July 31, 1914. These were first noted as small yellow spots among the intestinal villi. Later three larger cysts were found among the pyloric caeca. The egg-filled portion of one of these trematodes which was removed from its cyst measured 1.45 mm. in length and 1.71 mm. in breadth. A protruding anterior end measured 0.45 mm. in length; breadth, anterior, 0.30 mm., posterior, 0.03 mm.; oral sucker, length, 0.15 mm., breadth, 0.12 mm.; no pharynx noted. Ova, 0.021 by 0.014 mm.

Another, an immature specimen, was somewhat dumbell shaped. Measurements: Length, 1.24 mm., breadth of anterior portion, 0.30 mm., of middle portion 0.04 to 0.07 mm., posterior portion, 0.48 mm.; oral sucker, length, 0.10 mm., breadth, 0.09 mm.; pharynx, length, 0.04 mm., breadth, 0.02 mm.

Among the numerous specimens in the collection mounted in balsam is one in which the anterior ends of two trematodes protrude side by side from the oblong massive portion in which only folds of the uterus, crowded with ova, and a few portions of the tubular vitellaria can be made out. In one of these the uterus, and in the other the ejaculatory duct can be seen, each opening at the posterior

border of the oral sucker. In addition to the uterus and vitellaria, two small, deeply staining bodies, opposite each other and situated at the margin, a little in front of the middle of the length of a flattened specimen, were interpreted as the testes, and another on the median line, a little back of the middle, as the ovary. No pharynx can be made out satisfactorily in this specimen, although a faint indication of one appears in the head of the female. Another specimen with a reniform massive portion containing the uterus, etc., also has two protruding heads side by side. These differ considerably in size. Measurements of female: Breadth at level of oral sucker, 0.18 mm.; oral sucker, length, 0.075 mm., breadth, 0.090 mm. Measurements of male: Breadth at level of oral sucker, 0.06 mm.; oral sucker, length, 0.045 mm., breadth, 0.060 mm. Length of common egg-containing portion, 0.70 mm., breadth, 1.12 mm.

Eight cysts, collected by Vinal N. Edwards, September 22, 1914, from pyloric caeca. These were at first taken to be pedicelled cysts, but they proved to be pyloric caeca in the lumens of which the trematodes were lodged.

Four, collected June 29, 1915, encysted in the pyloric caeca, yellow; largest, length, 9 mm., breadth, 4.5 mm.; smallest, length, 3 mm., breadth, 1.5 mm.; ova, 0.028 by 0.014 mm.

WEDLIA XIPHIADOS (G. A. and W. G. MacCallum)

Koellikeria xiphiados (G. A. and W. G. MacCallum), Zool. Jahrb., vol. 39, pp. 148-153, figs. 1-5, 1916.

Cysts from flesh behind gill cavity collected July 21, 1913. These cysts came from a swordfish (*Xiphias gladius*), taken by Charles Grinnell. The specimens had been more or less mutilated, but it was possible to trace a slender tube containing blood vessels from each cyst toward the gill cavity. Before this material was turned over to Dr. MacCallum, who was giving special attention to trematodes on the gills of fishes, a few notes were made. Upon comparing my notes with the detailed description given by the MacCallums I find them in agreement, with the exception of the dimensions of the ova. These are stated in the description of the species to be 0.06 mm. in diameter. My notes give the dimensions as 0.021 by 0.016 mm. In some ivory white tubules the ova were slightly smaller than the yellow, older ova. They measured 0.020 by 0.016 mm., and, so far as observed, had developed to the two-celled stage.

A short papilla, 4 mm. long and 4 by 3 mm. in diameter, was observed on the side of one of the trematodes. It had a mouthlike opening at the end and along one side. Within the papilla there was a thin membrane, richly supplied with blood vessels, which appeared to be distributed generally among the tubular genitalia of the trematode.

One of these trematodes after removal from its cyst measured 40 by 28 by 24 mm.

Family HETEROPHYIDAE Odhner, 1914

Genus CRYPTOCOTYLE Lühe, 1899

CRYPTOCOTYLE LINGUA (Creplin)

Cryptocotyle lingua (Creplin), RYDER, Bull. U. S. Fish Comm. for 1884, pp. 37-42, 1884.—LINTON, Bull. U. S. Fish Comm. for 1899, pp. 281, 296, pl. 40, figs. 70-81, 1900; *ibid.*, pp. 462, 463, fig. 318, 1901.—RANSOM, Proc. U. S. Nat. Mus., vol. 57, pp. 544-548, 1920.—LINTON, Proc. U. S. Nat. Mus., vol. 73, art. 1, pp. 19-20, 1928.—STUNKARD and WILLY, Amer. Journ. Trop. Med., vol. 9, pp. 117-128, 6 figs., 1929.—STUNKARD, Journ. Morph. and Physiol., vol. 50, pp. 143-191, pls. 1-4, 1930.

Dermocystis ctenolabri STAFFORD, Zool. Anz., vol. 28, p. 682, 1905.

Tocotrema lingua (Creplin), LINTON, Journ. Parasit., vol. 1, pp. 128-134, 3 figs., 1915.

The following record of distomes encysted in the skin of Woods Hole fishes is compiled from notes made on various occasions from 1903 to 1927. Many of the notes were made while small fishes were being examined for their food, and are, consequently, difficult to reduce to a tabular form. Also, since it was not always possible to give exact numbers, approximations are marked with a plus-or-minus sign in the tabular summary.

In some cases these cysts occur in great numbers. Thus, a window-pane (*Lophopsetta maculata*) 32 cm. in length and 24 cm. in breadth, was examined for cysts on July 14, 1924, and the following note made: The entire surface, including the fins, was densely and uniformly peppered with encysted distomes, with the usual accompanying pigmentation; several on corneas of eyes; mouth, pharynx, and gills thickly beset with them. Counts were made at different places on the surface and it was found that 50 per square centimeter would be a conservative estimate of the degree of infection. The number of cysts on the surface, not including the mouth, pharyngeal and gill regions, according to this estimate would be about 76,800.

These cysts are very common on the tautog (*Tautoga onitis*). Thus, in 1908, 97 tautogs, from 8.5 to 34 cm. in length, were examined on 16 dates, from July 23 to September 3. Only an occasional fish was noted on which cysts were not present on the fins, and in most cases on the sides. Occasionally one is recorded as having large numbers of cysts. Thus, one seined at the Weepeckets, August 4, length 27 centimeters, had approximately 75 cysts on each eye. Eleven scales taken at random from the sides had an average of 10.2 cysts per scale, ranging from 0 to 13 mm.

The cunner (*Tautoglabrus adspersus*) is probably more generally infested by this parasite (U.S.N.M. No. 8393) than any of the Woods Hole fishes, with the possible exception of the tautog.

The late Dr. Irving T. Field, who, in 1903, was studying the food of cunners, reported that large numbers of them had cysts in the skin. Vinal N. Edwards in 1905 reports that he examined over 200 cunners taken in the seine at Quisset Harbor and found all to be infected. He states that he looked them over carefully to see if he could find one that was free from skin parasites, but did not find any that was clear of cysts. He also reports that he examined 100 cunners at Menemsha Bight, taken in fish trap and by seine, but saw no skin parasites. The cunners of Menemsha, however, are not always free from these cysts. Thus, on July 29, 1908, 21 cunners, seined at Menemsha, were examined. The larger fish had numerous cysts on the fins and sides; the smaller fish were, most of them, lightly infested, although one of the smallest, 8 cm. in length, had numerous cysts. Cunners from the fish trap at Menemsha, however, were found to be practically free from skin parasites, while those from traps in Buzzards Bay, near Woods Hole, were frequently heavily parasitized. In more or less enclosed bodies of water the infection is often high. Thus, at Sheep-pen Cove, August 12, 1908, three cunners were taken, each of which was densely peppered with black pigment spots; 24 scales were taken at random from the side of the larger one, 18 cm. in length. The average number of cysts per scale was 7.25; largest number on one scale 19. Also, at Hadley Harbor on August 24, 60 cunners, chosen at random from a large number taken in the seine, were examined; 29 of them were densely covered with cysts. The body and fins were almost black, with some

TABLE 38.—*Cysts of Cryptocotyle lingua on skin and fins of Woods Hole fishes*

| Host | Month | Number of days | Number of fishes examined | Cysts | | | |
|--|-------------------------------|----------------|---------------------------|-------|-------|-------|----------|
| | | | | None | Few | Many | Numerous |
| <i>Acanthocottus aeneus</i> | July, Aug..... | 2 | 6 | 2 | 4 | ----- | ----- |
| <i>Gadus morhua</i> | Dec..... | 1 | 1 | ----- | ----- | ----- | 1 |
| <i>Lophopsetta maculata</i> | May, July, Aug., Sept..... | 9 | 23 | 5 | 11 | 1 | 6 |
| <i>Menticirrhus saxatilis</i> | Aug., Sept..... | 6 | 16 | 12 | 4 | ----- | ----- |
| <i>Menidia notata</i> | July, Aug., Sept.. | 10 | 121 | 81 | 20 | ----- | ----- |
| <i>Microgadus tomcod</i> | Apr., Aug., Dec.. | 5 | 27 | ----- | ----- | 14 | 13 |
| <i>Mullus auratus</i> | Sept..... | 2 | 3 | 2 | 1 | ----- | ----- |
| <i>Osmerus mordax</i> | Aug..... | 2 | 21 | 15 | 6 | ----- | ----- |
| <i>Photis gunnellus</i> | Aug..... | 1 | 1 | 1 | 1 | ----- | ----- |
| <i>Pollachius virens</i> | Apr., Aug..... | 2 | 3 | ----- | 3 | ----- | ----- |
| <i>Pomatomus saltatrix</i> | July, Aug., Sept.. | 1 | 70 | 67 | 3 | ----- | ----- |
| <i>Poronotus triacanthus</i> | July, Aug..... | 3 | 3 | ----- | ----- | ----- | 3 |
| <i>Pseudopleuronectes americanus</i> | July, Aug., Sept.. | 12 | 67 | ±34 | ±30 | ----- | 3 |
| <i>Scomber scombrus</i> | July, Aug..... | 10 | 78 | 54 | 20 | 4 | ----- |
| <i>Tautoga onitis</i> | July, Aug., Sept.. | 29 | 112 | ±7 | ±65 | ±30 | ±10 |
| <i>Tautoglabrus adspersus</i> | July, Aug., Sept.. | 48 | 815 | ±173 | ±445 | ±48 | ±148 |
| <i>Trachinotus falcatus</i> | Sept..... | 2 | 6 | 1 | 5 | ----- | ----- |

blotches of red, and a ground color of dark blue. The mucous membrane of the mouth and the tongue was thickly covered with cysts.

In all cases but one the distomes which were removed from cysts and examined belonged to the species *C. lingua*. The exception was in cysts from two specimens of *Menidia notata* seined in Great Harbor, August 29, 1908, two cysts on the caudal fin of each, and three on each side of one.

The foregoing tabular summary is unsatisfactory in some particulars. For example these cysts are of rather frequent occurrence in *Microgadus tomcod* and *Poronotus triacanthus*, which could hardly be inferred from the table.

The life history of this distome has recently been worked out by Dr. H. W. Stunkard. An abstract of his paper appeared in the Collecting Net, vol. 5, p. 268.

Family CLINOSTOMIDAE Lühe, 1901

Genus CLINOSTOMUM Leidy, 1856

CLINOSTOMUM MARGINATUM (Rudolphi)

Clinostomum marginatum (Rudolphi) H. L. OSBORN, Biol. Bull., vol. 20, pp. 350-356, pl. 1, 1911; Journ. Morph., vol. 23, pp. 189-228, pls. 1-3, 1912.

The following records of the encysted stage of this widely distributed parasite add some localities to those included in Osborn's publications.

Hosts.—Brook trout (*Salvelinus fontinalis*), large-mouthed black bass (*Huio floridana*), small-mouthed black bass (*Micropterus dolomieu*), yellow perch (*Perca flavescens*).

Record of collections.—Two distomes of this species, from the flesh of the brook trout from Alder Lake, Delaware County, N. Y., were sent to me by Dr. Tarleton H. Bean; date of sending November 27, 1910. Length of larger, 7 mm.; breadth, 0.8 mm.

A considerable number of trout (U.S.N.M. No. 8395) were examined for flesh parasites at Alder Lake from June 26 to June 28, 1911. Unfortunately the notes of this examination are missing. Distomes were found in the flesh of several trout, usually just beneath the skin. They were not numerous in any of the fishes. Specimens mounted in balsam measure from 3.6 to 8 mm. in length. Measurements of one of the larger specimens in balsam: Length, 8 mm.; maximum breadth, 1.9 mm.; oral sucker, length, 0.30 mm., breadth, 0.33 mm.; ventral sucker, length, 0.85 mm., breadth, 0.92 mm.

Alder Lake is about 40 acres in extent. No other fish than trout are in the lake.

Ten large-mouthed black bass (U.S.N.M. No. 8394), taken in Bass Lake, White Earth Reservation, Minn., and preserved in formalin,

were examined at the Laboratory of the Bureau of Fisheries, Woods Hole, Mass., August 6, 1919. The fish had been collected at the instance of Dr. Earl A. Danielson, of Litchfield, Minn. Letters accompanying the collection were dated June 18 and 23. The fish were sent on account of their infestation with the tapeworm *Proteocephalus ambloplites*. Immature distomes were found in the flesh of eight of the ten fishes, from 3 to 27 in each, 108 in all. Measurements in balsam: Length, 5 mm.; breadth, at level of oral sucker, 0.81 mm., at level of ventral sucker, 1 mm., maximum, 1.22 mm.; oral sucker, length, 0.25 mm., breadth, 0.26 mm.; diameter of ventral sucker, 0.64 mm.

Received on October 23, 1902, caudal and dorsal fins and pieces of the flesh of small-mouthed black bass, taken by the Rev. James H. Young, Troy, Ohio, in Lost Creek, Miami County, Ohio. Mr. Young stated that the bass taken during the summer were nearly all infested with parasites, on the fins and in the flesh, especially along the backbone. These parasites proved to be *C. marginatum*. One removed from its cyst measured 4.5 mm. in length and 2 mm. in breadth.

Three small-mouthed black bass (U.S.N.M. No. 8396), about 4 cm. in length, sent to the Laboratory of the Bureau of Fisheries, Woods Hole, Mass., by Deputy Fish and Game Warden Charles Meyers, Far Hills, N. J., were received on July 29, 1915. The fish were taken from Ravine Lake, Somerset Hills Country Club.

Five encysted distomes of *C. marginatum* were found, one cyst on the gills, one in the gill cavity, and three in the flesh. Those on the gills and in the gill cavity were bright yellow, the others pale yellow. The largest, from the flesh, in formalin measured 9 mm. in length. Measurements in balsam: Length, 8.5 mm.; breadth, at level of oral sucker, 1.12 mm., at level of ventral sucker, 1.54 mm., maximum, 2.03 mm.; diameter of oral sucker, 0.36 mm., ventral sucker, 0.70 mm., breadth, 0.83 mm.

Received from Dr. Tarleton H. Bean on June 8, 1915, distomes collected from yellow perch in Honeoge, and neighboring lakes, by Ward's Natural Science Establishment. There were seven distomes in the vial, all *C. marginatum*. Lengths, in formalin, 4 to 6 mm.; breadth, 1.5 mm. Some with fragments of cysts attached.

Family STRIGEIDAE Railliet, 1919

Genus TETRACOTYLE Filippi, 1854

TETRACOTYLE COMMUNIS Hughes

PLATE 24, FIGURE 319

Tetracotyle communis HUGHES, Trans. Amer. Micr. Soc., vol. 47, pp. 415-419, figs. 1, 5, 6, 8-11, 1923.

Encysted trematodes from a fresh-water fish, the wall-eyed pike (*Stizostedion vitreum*), are here recorded.

Cysts from fish from market, Washington, Pa. (U.S.N.M. No. 8397), presumably from Lake Erie, collected March 7, 1891. A slide in my collection contains sections of a cyst with enclosed larval trematode, and of a trematode which had been removed from its cyst.

The structure of cyst and larva, so far as shown in these sections, agrees with the detailed description given by Hughes, but there is no trace of spines, and the pharynx is not well shown.

Measurements of cyst, 0.80 by 0.60 mm.; of contained larva, length, 0.55 mm., breadth, 0.42 mm.; ventral sucker, breadth, 0.17 mm., vertical diameter, 0.17 mm.; oral sucker, length, 0.11 mm., breadth, 0.14 mm.

Genus NEASCUS Hughes, 1927

NEASCUS CUTICOLA (van Nordmann)

PLATE 24, FIGURES 320-323

Diplostomum cuticola Diesing, LINTON, Proc. U. S. Nat. Mus., vol. 20, p. 513, pl. 41, figs. 1-10, pl. 42, figs. 1-5, 1898.

Diplostomum cuticolu (van Nordmann), LÜHE, Brauer's Süßwasserfauna Deutschlands, Trematodes, pp. 166, 167, 1909.

Neascus cuticola (van Nordmann), HUGHES, Trans. Amer. Micr. Soc., vol. 47, pp. 331, 332, figs. 3, 9-11, 1928.

The encysted trematodes from four species of fresh-water fishes here recorded, although differing somewhat in the relative proportions of the suckers, so far as the anatomy is shown, agree with descriptions of this species.

Hosts.—Large-mouthed black bass (*Huro floridana*), small-mouthed black bass (*Micropterus dolomieu*), brook trout (*Salvelinus fontinalis*), yellow perch (*Perca flavescens*).

Record of collections.—Specimens of large-mouthed black bass were received on July 8, 1915, from Dr. E. E. Smith. They were collected by T. C. H. Richardson, who stated that the fish came from a reserve pond where the fish were dying off. The location of the pond was not given, but it is in New Jersey, not far from New York City. Numerous cysts on fins and in the muscle tissue. The cysts were surrounded by black pigment. A cyst in glycerin measured 0.40 by 0.23 mm.; estimated length of larval trematode in cyst, 0.54 mm.

Ten large-mouthed black bass were received on July 31, 1919. The fishes had been taken in June from Bass Lake, White Earth Reservation, Minn., and had been collected and sent at the instance of Dr. Earl A. Danielson. The fishes had been sent on account of heavy cestode infection. Cysts surrounded by black pigment were found on each of the fish, from 2 to 35 on each, most of them on the

fins, but also under the skin and a few in the flesh. In all 95 cysts were noted, of which 61 were on the fins, 32 under the skin, and 2 in the flesh. Measurements of larva in glycerin: Length, 0.30 mm.; breadth, 0.15 mm.; oral sucker, length, 0.060 mm., breadth, 0.039 mm.; ventral sucker, not distinct, length about 0.042, breadth about 0.024 mm.

Pieces of the skin and fins of small-mouthed black bass, with many pigmented cysts, were received on October 3, 1902. The fishes were collected by the Rev. James H. Young at Troy, Ohio. A larva removed from its cyst measured 0.4 mm. in length and 0.2 mm. in breadth.

Received on September 25, 1903, pieces of skin with underlying muscle tissue of small-mouthed black bass with cysts surrounded by black pigment. The bass were taken from a fresh water pond near Portland, Maine. It was stated that the yellow perch and sunfish in the pond were similarly affected. Larvae removed from cysts measured 0.4 mm. in length and 0.2 mm. in breadth.

A small-mouthed black bass, taken on November 15, 1907, by James L. Robertson from Culver Lake, Branchville, N. J., was sent to me on account of the large number of cestodes in the body cavity. Pigmented cysts containing larval trematodes were found in the flesh.

Three small-mouthed black bass (U.S.N.M. No. 8398) were received on July 29, 1915, from Charles Meyers, Deputy Fish and Game Warden, Far Hills, N. J. The fishes had been taken in Ravine Lake, Somerest Hills Country Club. Mr. Meyers stated that the bass in the lake were heavily infested with these parasites, especially on the fins and in the mouth. There were numerous cysts with black pigment on these fishes; most abundant on the caudal and pectoral fins, on the cheeks and opercular region, also on inner side of opercle; a few in the mouth, and scattering cysts on the scales of the sides. Many cysts were found in the skin. They were not visible from the outside, but upon removing the skin they were found to be rather abundant along the sides. A piece of skin about 5 cm. square had about 25 cysts on the inner side. Most of these cysts were in the subdermal connective tissue, but one was noted just back of the head at a depth of 8 mm.; a few were found among the neural spines under the dorsal fin, as much as 20 mm. from the surface. The largest cyst noted was 2.5 mm. in diameter; usual size about 1 mm. in diameter. The pigmented area is much larger than the cyst. Fifty-three cysts were counted on an 18 mm. square on a pectoral fin, and 72 on a similar area on a caudal fin. Measurements of a formalin specimen removed from its cyst: Length, 0.8 mm.; breadth, neck, 0.28 mm., at level of ventral sucker, 0.26 mm.; posterior end to ventral sucker, 0.30 mm.; diameter of oral sucker, 0.07 mm.,

of pharynx, 0.04 mm., of ventral sucker, 0.04 mm.; middle and anterior regions with numerous subspherical bodies from 0.007 to 0.010 mm. in diameter. Measurements in balsam: Length, 0.90 mm. (fore and hind body about equal); maximum breadth, 0.30 mm.; breadth of oral sucker, about 0.07 mm., of pharynx (indistinct) about 0.024, of ventral sucker, 0.036 mm. In another balsam specimen: Breadth of oral sucker, 0.054 mm., of ventral sucker, 0.033 mm.; hold-fast organ, length, 0.069 mm., breadth, 0.048 mm.

On July 3 and 4, 1904, a number of brook trout, 60 more or less, were examined for skin parasites, at Alder Lake in the Catskills, near Turnwood, N. Y. Many of them had cysts surrounded by black pigment on the skin. None of the fish had large numbers of cysts. A few had as many as from 25 to 30 cysts on each side. Some had from one to five cysts on a side; others were free from cysts. The cysts lie just beneath the epidermis so that a considerable number of them produce an embossed surface which can be detected by passing the hand lightly over it. Many of these cysts were opened and found to contain larval trematodes, all apparently of the same species. The cysts were from 0.4 to 0.7 mm. in diameter. One cyst 0.56 mm. in diameter had walls 0.15 mm. thick. The liberated larva was 0.22 mm. in length and 0.14 mm. in breadth. A larva removed from its cyst and flattened under the cover glass had the following measurements: Length, 0.28 mm.; diameter of oral sucker, 0.044 mm., of pharynx, 0.020 mm., of ventral sucker, 0.054 mm. A transverse slit with deeply staining walls, marking the position of the hold-fast organ, is a conspicuous feature. A report of this investigation was published in "The diagnosis of a case of parasitism in the brook trout," *Proc. Int. Zool. Cong.*, 1907, pp. 629, 632.

On May 25, 1908, I received from Dr. Tarleton H. Bean three yellow perch (U.S.N.M. No. 8399) which had been taken in Amper-sand Pond, in the Adirondacks, by J. C. Hanchett, Superintendent of Knollwood Club. The fishes were thickly covered with encysted trematodes, surrounded by black pigment, similar in appearance to those of the brook trout. The cysts were distributed indiscriminately over the body, on the fins and eyes, each containing an immature trematode larva.

Seven yellow perch were seined in a fresh-water pond at Quisset, near Woods Hole, on July 1, 1913. A few trematode cysts in the skin, beneath the scales. Cyst, 0.48 by 0.40 mm.; larva liberated from the cyst, but still enveloped in a thin membrane, 0.30 by 0.20 mm. Another cyst, 0.49 mm. in diameter, contained a larval trematode, length, 0.25 mm., breadth, 0.17 mm.

UNCLASSIFIED FORMS

Genus *PLEORCHIS* Railliet, 1896*PLEORCHIS AMERICANUS* Lühe

PLATE 24, FIGURES 324-330

Distomum polyorchis Stossich, LINTON, Bull. U. S. Fish Comm. for 1899, pp. 460, 461, figs. 363-365, 1901.

Pleorchis americanus LÜHE, Rep. Pearl Oyster Fish. Gulf of Manaar, pt. 5, p. 103, 1906.

Revised description of species: Of nearly the same breadth throughout most of the length, tapering slightly from a point a little back of the ventral sucker to the anterior end; posterior end more or less truncate; body covered with flat, round-pointed spines. Oral and ventral suckers nearly equal; pharynx much smaller than oral, from which it is separated by a prepharynx; prepharynx and esophagus each longer than the oral sucker. The rami of the intestines extend to the posterior end of the body, each sending off numerous branches, which themselves may branch one or more times. In the vicinity of the testes this branching is only on the lateral sides, but behind the testes the branching is both lateral and medial; anteriorly each ramus is prolonged into a caecum which extends forward beyond the level of the anterior end of the pharynx. The genital pore is on the median line in front of the ventral sucker. The cirrus is smooth; the cirrus-pouch lies dorsal to the right side of the ventral sucker, encloses the seminal vesicle, which is in two divisions, and extends well back of the ventral sucker. Testes numerous, lying in two double rows, dorsal and ventral, on each side of the median line for a distance approximating half the length of the body. In the specimen of which the measurements are given the distance from the anterior end to the first testis is 2.6 mm., from the last testis to the posterior end, 1.1 mm., while the distance from the anterior to the posterior testis inclusive is 3.7 mm. The ovary is lobed, morulalike in horizontal section, and lies at the anterior borders of the first testes, more of it on the right than on the left side of the median line. The shell gland lies on the anterior border of the ovary. Laurer's canal enters about on the median line dorsal to the anterior border of the ovary. There is no seminal receptacle, the early folds of the uterus acting in that capacity. The folds of the uterus lie between the ovary and ventral sucker, passing on the dorsal side of the ventral sucker to the genital pore. The vitellaria fill the body behind the testes, and form broad lateral bands forward to about the level of the posterior edge of the ventral sucker. The main excretory vessel is single and on the median line. Ova rather

numerous, in balsam mounts, maximum, 0.078 by 0.048 mm. Measurements in balsam: Length, 7.4 mm.; maximum breadth, 2.2 mm.; breadth at ventral sucker, 1.9 mm.; length of prepharynx and esophagus each about 0.4 mm.; oral sucker, length, 0.32 mm., breadth, 0.36 mm.; pharynx, length, 0.19 mm., breadth, 0.22 mm.; ventral sucker, length, 0.31 mm., breadth, 0.32 mm.; ova, 0.069 by 0.045 mm. In a series of cross sections of a specimen 1.4 mm. in breadth, the breadth of the oral sucker is 0.31 mm., vertical diameter, 0.25 mm.; diameter of pharynx, 0.17 mm. in each direction; ventral sucker, breadth, 0.28 mm., vertical diameter, 0.25 mm.; ova, 0.078 by 0.045 mm.

In a series of sagittal sections there are 14 pairs of testes on one side of the median line and 15 on the other. In this series of sections Laurer's canal is on the dorsal side a little to the right of the median line and about on a level with the anterior third of the ovary. The canal was traced to the oviduct which is entered just before the oviduct expanded into the uterus which was there filled with sperm and ova intermingled.

Host.—Squeteague (*Cynoscion regalis*).

Record of collections.—Four (U.S.N.M. No. 8400), collected July 27, 1904 (two were white and two faint pink, more deeply colored anteriorly). One, collected July 11, 1905. One, collected July 17, 1905, from pyloric caeca of host. One, collected August 28, 1907; length, 6.5 mm.; breadth, 2 mm.; excretory vessel large, sacculate, along median line, toward posterior end.

GARGORCHIS¹⁶ new genus

Characters of genus: Cuticle spinose; ventral sucker larger than oral; esophagus present; rami of intestine long; main excretory vessel a single median trunk from posterior end to ventral sucker; genital opening in front of ventral sucker; cirrus pouch extending back of ventral sucker and enclosing a seminal vesicle. A second seminal vesicle lies at the posterior end of the cirrus pouch. Testes many (11 in type species), median, behind ovary; ovary behind ventral sucker and in front of testes; seminal receptacle near ovary; vitellaria diffuse; uterus mainly in front of ovary.

GARGORCHIS VARIANS, new species

PLATE 24, FIGURE 331; PLATE 25, FIGURES 332-340

Body covered with minute spines, dense anteriorly, sparse posteriorly, rather plump, usually broadest at level of ventral sucker, with short neck and tapering postacetabular region, but may be

¹⁶ γάργαρα, plenty + ὄρχις, testis.

either long or short oval-elliptical, or fusiform; neck very variable, usually strongly contracted in preserved specimens. Oral sucker subterminal, usually broader than long; prepharynx short; pharynx of good size, usually longer than broad, approximately as long as the oral sucker and about half as broad; esophagus as long as or longer than the pharynx, but often appearing shorter on account of the contracted condition of the neck; intestinal rami with thick walls and extending to the posterior end. The ventral sucker is much larger than the oral, its opening transverse. The genital pore is in front of the ventral sucker to the left of the median line, and about on a level with the posterior end of the pharynx. The cirrus is smooth, the cirrus-pouch long-pyriform, muscular, extending back of the ventral sucker on the left side and enclosing a seminal vesicle at its posterior end. A second seminal vesicle lies behind and beside the posterior end of the cirrus-pouch. The second seminal vesicle and the base of the cirrus-pouch are surrounded by cells of the prostate gland. Testes, eleven in number so far as observed, roundish or subtriangular in outline, median, in two more or less irregular longitudinal rows, in the posterior half of the postacetabular region. Ovary small, about 3-lobed, in front of testes, and usually a little to the right of the midventral line; in most cases behind the level of the seminal vesicles, but in some cases on a level with the base of the cirrus pouch, and near the ventral sucker. The shell gland and yolk reservoir are at the posterior border of the ovary. There is a seminal receptacle behind the ovary. It is dorsally placed with respect to the ovary, and in compressed specimens may appear to be to the right of the median line in some cases, to the left in others; often it appears to be to the right of the median line and on a level with the anterior testes. Laurer's canal was seen in a series of cross sections (fig. 339). The diffuse vitellaria fill the greater part of the space back of the testes and extend forward nearly or quite to the ventral sucker. The uterus lies between the testes and ventral sucker; the metraterm lying beside the cirrus pouch and lateral to it, joining the cirrus pouch very near the genital pore. The ova are thin-shelled; maximum in balsam about 0.060 by 0.036 mm.

The relative positions of ovary, seminal vesicles, seminal receptacle and first testes are subject to some variation with different degrees of contraction, and with varying amounts of sperm in the vesicles.

The main excretory vessel is conspicuous in living specimens, and was traced from the terminal excretory pore to a point dorsal to the ventral sucker. In series of cross sections the excretory vessel was traced to the level of the ventral sucker, but the arrangement of the excretory vessels in the neck was not satisfactorily shown.

Measurements, average of nine specimens, in balsam: Length, 2.28 mm.; breadth, 0.82 mm.; oral sucker, length, 0.20 mm., breadth, 0.23 mm.; pharynx, length, 0.20 mm., breadth, 0.13 mm.; ventral sucker, length, 0.32 mm., breadth, 0.35 mm.; ova about 0.06 by 0.03 mm. Longest of the nine specimens, length, 3.08 mm., breadth, 0.63 mm.; broadest of the nine specimens, length, 2.01 mm., breadth, 0.94 mm.

Average of nine specimens in balsam, more or less oval-elliptical in outline, post-acetabular region not tapering: Length, 1.31 mm.; breadth, 0.67 mm.; oral sucker, length, 0.16 mm., breadth, 0.20 mm.; pharynx, length, 0.15 mm., breadth, 0.10 mm.; ventral sucker, length, 0.27 mm., breadth, 0.32 mm.; ova, 0.054 by 0.033 mm. to 0.063 by 0.039 mm. Longest of the nine specimens, length, 2.10 mm.; breadth, 0.94 mm.; broadest of the nine specimens, length, 1.98 mm.; breadth, 1.08 mm.

Type specimens.—U.S.N.M. No. 8401 (holotype and paratypes).

Host.—Filefish (*Ceratacanthus schoepfi*).

Record of collections.—Thirty, collected August 7, 1905. At first pale pinkish, bleaching to translucent bluish white after lying in sea water for some time; very various shapes, becoming a little more uniform when placed in 70% alcohol. Measurements in glycerin, compressed: Length, 2.94 mm.; breadth, 1.05 mm.; oral sucker, length, 0.25 mm., breadth, 0.32 mm.; pharynx, length, 0.25 mm., breadth, 0.20 mm.; ventral sucker, length, 0.45 mm., breadth, 0.45 mm.

Five specimens, collected August 19, larger specimens turgid and translucent, smaller specimens yellowish or flesh colored; maximum length, 2.8 mm.

Four, collected July 29, 1908; turgid, necks very short.

Numerous, collected August 19, 1908, various shapes.

Twenty-four, collected July 11, 1910; the living and active worms were yellowish with a faint tinge of red; greatest diameter at level of ventral sucker; neck usually contracted; postacetabular region tapering; the conspicuous excretory vessel was traced from a point a little in advance of the dorsal border of the ventral sucker to the posterior end. The wall of the excretory vessel altered in appearance while the specimen was under observation. Longitudinal and transverse fibers in its walls, in certain stages of contraction, gave to the wall a checkered appearance. Inactive specimens were squarish-oblong in outline, but when flattened under the cover glass they assumed outlines similar to those of the active specimens. Still others were turgid, semitransparent, with their vitellaria much reduced. Two of the small, active distomes were placed in fresh water where they soon became turgid, and then resembled closely the distomes which were inactive when first removed from the intestine of the fish and

placed in sea water. The fish from which these distomes were obtained had been dead for several hours.

Fifty, more or less, collected July 13, 1911, from intestine of host.

Fifty, or more, collected August 21, 1915; some yellow, others white.

Fifteen, collected July 28, 1920, about 2 mm. in length.

Fifty-six, collected August 27, 1926; relatively shorter and broader than the usual forms.

Eighty-five more or less (U.S.N.M. No. 8401), collected by Dr. E. B. Krumbhaar, August 17, 1929. Two types, agreeing with foregoing descriptions; one white, obtuse, inactive; the other broadest at ventral sucker, postacetabular region more or less elongated, color yellowish tinged with red, active.

Genus STENOCOLLUM Stafford, 1904

STENOCOLLUM FRAGILE (Linton)

Distomum fragile LINTON, Bull. U. S. Fish Comm. for 1899, pp. 282, 295, figs. 68-70, 1900; *ibid.*, p. 466, 1901.

Stenocollum fragile (Linton), STAFFORD, Zool. Anz., vol. 27, p. 487, 1904.

One example of this distome (U.S.N.M. No. 8402), somewhat macerated, was collected from the intestine of a sunfish (*Mola mola*) July 19, 1926.

Genus DERETREMA Linton, 1910

DERETREMA FUSILLUS Linton

PLATE 25, FIGURES 341-344

Deretrema fusillus LINTON, Carnegie Inst. Washington Publ. 133, pp. 49, 50, figs. 102-104a, 1910.

Four distomes from a flyingfish, collected on three different dates at Woods Hole, are referred to this species, although, as was the case with the Tortugas material, showing considerable variation among themselves.

The body is smooth, fusiform, broadest at level of ventral sucker; no prepharynx, esophagus not longer than pharynx; intestinal rami extend back of ventral sucker, but not to the posterior end; genital pore at left side of neck; cirrus pouch large, in front of ventral sucker and enclosing the seminal vesicle and prostate; testes behind ventral sucker, opposite. Ovary in front of right testis, at right posterior border of the ventral sucker; seminal receptacle behind ovary. The vitellaria consist of a few follicles lateral to the ventral sucker and testes; shell gland and yolk reservoir between the testes. The uterus, beginning at the shell gland, fills with its voluminous folds all of the post-testicular region of the body and also a considerable portion of the region behind and dorsal to the ventral sucker. The metraterm,

seen in only one specimen, appears to lie in front and to the right of the cirrus-pouch, and to open at the genital pore. All of the specimens are more or less distorted by compression. The ova are numerous, elliptical, from 0.033 by 0.018 mm. to 0.037 by 0.021 mm.

The excretory pore and a small portion of the excretory vessel are visible in one of the mounted specimens, but little can be distinguished on account of the dense mass of ova with which the posterior end of the body is filled.

TABLE 39.—Measurements of four specimens of *Deretrema fusillus* in balsam

| Measurement | 1 | 2 | 3 ¹ | 4 |
|---|------------|------------|----------------|------------|
| | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> | <i>Mm.</i> |
| Length..... | 1.15 | 1.36 | 2.10 | 2.87 |
| Breadth..... | .68 | .68 | .84 | 1.12 |
| Oral sucker, length..... | .12 | .11 | .28 | .27 |
| Oral sucker, breadth..... | .11 | .17 | .32 | .32 |
| Pharynx, length..... | .11 | .11 | .14 | .22 |
| Pharynx, breadth..... | .10 | .11 | .14 | .22 |
| Ventral sucker, length..... | .35 | .35 | .42 | .42 |
| Ventral sucker, breadth..... | .25 | .28 | .35 | .35 |
| Posterior edge of ventral sucker to anterior end..... | .63 | .87 | 1.10 | 1.27 |

¹ No. 3 ventral view, others lateral view.

Host.—Sharp-finned flyingfish (*Exocoetus volitans*).

Record of collections.—One, collected July 16, 1910. Two, collected August 9, 1910. One (U.S.N.M. No. 8403), collected August 27, 1928.

Genus SIPHODERA Linton, 1910

SIPHODERA VINALEDWARDSII (Linton)

Monostomum vinalwardsi LINTON, Bull. U. S. Fish Comm. for 1899, p. 470, figs. 373–376, 1901.

Monostomum vinal-edwardsi LINTON, Bull. U. S. Bur. Fish., vol. 24, pp. 379, 410, 1905; Proc. U. S. Nat. Mus., vol. 33, p. 118, fig. 97, 1907.

Siphodera vinalwardsi (LINTON), Carnegie Inst. Washington Publ. 133, p. 74, figs. 208, 209a, 1910.—MANTER, Illinois Biol. Mon., vol. 10, pp. 107–110, figs. 80–83, 1926.

Hosts.—Toadfish (*Opsanus tau*) and alewife (*Pomolobus pseudoharengus*).

Record of collections.—No special search for this trematode has been made at Woods Hole since the first description of the species was published. I have record of collections from toadfish on four dates in August and one in October, in four different years, from 1903 to 1914; 17, from eight fishes; one to five worms in each. (U.S.N.M. No. 8404).

One, from alewife, collected July 26, 1906; length of living specimen, 2.52 mm., breadth, 1.12 mm.; ova, 0.021 by 0.010 mm.

Genus **MONOSTOMA** Zeder, 1800**MONOSTOMA** species

PLATE 26, FIGURE 345

A trematode, collected by Vinal N. Edwards from a cod (*Gadus morrhua*), December 16, 1905 (U.S.N.M. No. 8405), is here noted.

The specimen was stained and mounted in balsam, but shows but little of the anatomy. The sketch shown in figure 345 was made of the specimen lying in formalin. In the mounted specimen the cirrus is not so clearly outlined as in the sketch. A cirrus pouch is faintly shown, and testes are indicated along the median line toward the posterior end, but the number and outlines cannot be determined.

Measurements in formalin: Length, 1.82 mm.; breadth, anterior, 0.47 mm., middle, 0.58 mm., posterior, 0.39 mm.; breadth of anterior sucker, 0.47 mm.; diameter of cirrus, 0.07 mm.; distance of cirrus from posterior end, 0.7 mm. The margins are folded under ventrally; if flattened the breadth would be increased about 0.14 mm.

Genus **DISTOMA** Retzius, 1782**DISTOMA FENESTRATUM** Linton

PLATE 26, FIGURES 346-348

Distomum sp. LINTON, Bull. U. S. Bur. Fish., vol. 24, pp. 373, 374, figs. 213, 214 (from *Coryphacna equisetes* and *C. hippurus*), 1905.

Distomum fenestratum LINTON, Proc. U. S. Nat. Mus., vol. 33, pp. 111, 112, figs. 86-91 (from *Lycodontis moringa*), 1907; Carnegie Inst. Washington, Publ. 133, p. 51, figs. 105, 106 (from *Haemulon plumieri* and *H. sciurus*), 1910.—SUMNER, OSBURN, and COLE, Bull. U. S. Bur. Fish., vol. 31, pt. 2, p. 582 (from *Brevoortia tyrannus*), 1911.

Immature distomes, recorded from widely different hosts and localities, as indicated in the above references, are here reported.

Hosts.—Sand lance (*Ammodytes americanus*), menhaden (*Brevoortia tyrannus*), round herring (*Etrumeus sadina*), remora (*Remora remora*).

Record of collections.—Five (U.S.N.M. No. 8406), collected November 1, 1913; lengths in formalin, 2.4 to 3.5 mm.; breadths of three about 0.25 mm.; one measuring 2.85 mm. in length had a maximum breadth of 0.30 mm.; another, length, 3.23 mm.; breadth, 0.20 mm. Measurements in balsam: Length, 2.52 mm.; maximum breadth, about 0.45 mm. from posterior end, 0.24 mm.; anterior sucker, length, 0.051 mm., breadth, 0.036 mm.; diameter of ventral sucker, 0.11 mm.; distance from anterior end to posterior edge of ventral sucker, 0.28 mm.

From menhaden: One (U.S.N.M. No. 8407), collected July 4, 1905; fragment; posterior end showing characteristic constrictions

of the intestines, giving the appearance of distinct, nearly translucent bodies.

One, collected August 7, 1906, length, 2.38 mm. Measurements in balsam: Length, 1.54 mm.; breadth, near anterior end, 0.10 mm., at level of ventral sucker, 0.18 mm., maximum, 0.29 mm.; oral sucker, length, 0.054 mm., breadth, 0.051 mm.; ventral sucker, length, 0.09 mm., breadth, 0.10 mm.; length of neck, 0.16 mm.

From round herring: One, collected July 25, 1908; slender, white, very active, cylindrical before compression under the cover glass. The anterior part of the postacetabular region opaque, white by reflected light, yellowish brown by transmitted light. The posterior half of the postacetabular region contained eight pairs of transparent bodies, which are to be interpreted as being caused by somewhat regular constrictions of the walls of the voluminous intestinal rami. By reflected light they have the appearance of windowlike spaces occupied by a thin, transparent membrane; by transmitted light they have the appearance of thickish, bladderlike bodies with more or less lobed or crenulated outlines. The lobed character disappeared as the worm was kept under observation. The mouth is terminal. The anterior end was slightly invaginated. The surface was crossed by exceedingly fine wavy lines. Measurements, life: Length, 2.10 mm.; breadth, 0.24 mm.; diameter of ventral sucker, 0.09 mm.

Two (U.S.N.M. No. 8408), collected September 17, 1912. Measurements, life: Length, 2.24 mm.; maximum breadth, 0.36 mm.; oral sucker, length, 0.084 mm., breadth, 0.056 mm.; diameter of ventral sucker, 0.11 mm. The voluminous intestines were represented by five or six pairs of bladderlike structures at the posterior end of the body, anteriorly they continue as smaller, laterally placed bodies with finely granular contents. It was noted that at the posterior end beneath the cuticle there was a layer of nucleated cells. These specimens were stained and mounted in balsam but are not satisfactory. The 10 posterior divisions of the intestine are filled with a structureless material that does not take the stain. In the postacetabular region, which is more or less opaque in the living worm, cells, which appear to be arranged in rather squarish lateral masses were observed, beginning not far back of the ventral sucker. Behind these, and between the laterally placed smaller bodies, kinks in the intestinal rami, a lot of relatively large nucleated cells were observed.

In both of the mounted specimens the mouth is terminal, the oral sucker is longer than broad, and the ventral sucker is considerably larger than the oral. There is no pharynx; what was at first taken to be a pharynx in one proved to be a kink in the esophagus. The excretory pore is terminal.

From remora: Two (U.S.N.M. No. 8409), collected August 3, 1911; one of these was encysted in the stomach wall.

Measurements in balsam: Length, 3.78 mm.; breadth, at level of oral sucker, 0.07 mm., at level of ventral sucker, maximum, 0.30 mm., thence tapering to 0.14 mm. at posterior end; oral sucker, length, 0.08 mm., breadth, 0.06 mm.; ventral sucker, length, 0.11 mm., breadth, 0.10 mm. When one of these distomes was fixed under pressure the characteristic constrictions of the intestinal rami in large measure disappeared (figures 346, 347).

DISTOMA species

PLATE 26, FIGURES 349, 350

Record is here made of two trematodes from the kingfish. Both specimens are more or less macerated, and the very numerous ova obscure the genitalia in great degree.

Neck slender and tapering, body of about uniform breadth; prepharynx and esophagus both present, the latter relatively long; cirrus pouch large and elongated, enclosing the seminal vesicle; testes in the posterior third, their outlines obscured by ova; ovary median, in front of testes, and a short distance behind the posterior end of the cirrus pouch, apparently lobed. The vitellaria, consisting of six or eight follicles on each side, extends from the level of the ovary forward to the level of the posterior end of the cirrus pouch. The uterus, crowded with ova, fills the body from the cirrus pouch to the posterior end. The metraterm is much expanded and has thick, muscular walls. Musculature of ventral sucker weak.

These trematodes resemble unidentified forms from *Orthopristis chrysopterus* (Bull. U. S. Bur. Fish., vol. 24, pp. 379, 380, figs. 216, 218, 1905).

Host.—Kingfish (*Menticirrhus saxatilis*).

Record of collections: One (U.S.N.M. No. 8410), collected September 11, 1907. Anterior third, from level of genital pore, slender, tapering; posterior two thirds of length rather slender and of nearly uniform breadth. Measurements in balsam: Length, 2.21 mm.; breadth, anterior, 0.07 mm., at level of genital pore (0.5 mm. from anterior end) 0.28 mm.; diameter of oral sucker, 0.06 mm., of ventral sucker, 0.075 mm.; pharynx, length, 0.036 mm., breadth, 0.024 mm.; length of prepharynx, 0.09 mm., of esophagus, 0.42 mm.; ova, 0.021 by 0.012 mm.

One, collected July 21, 1926. Slender, fusiform, anterior end missing. Measurements in balsam: Length, 2.10 mm.; breadth, from level of genital pore to posterior end, 0.28 mm.; ova, 0.021 by 0.015 mm.

DISTOMA species

PLATE 26, FIGURE 351

Among the cysts containing larval distomes belonging to the genus *Echinostoma*, from *Percopsis omiscomaycus*, collected at Constantia, N. Y., Oneida Lake, June 6, 1915, two globular cysts, adhering to the eyeball, contained immature distomes which are generically different from the others. Measurements of one of the cysts, 0.66 by 0.57 mm.; the other, 0.45 mm. Measurements of distome, life: Length, 0.60 mm.; breadth, 0.60 mm.; diameter of oral sucker, 0.13 mm.; ventral sucker, length, 0.13 mm., breadth, 0.16 mm. These distomes, mounted in balsam, agree closely in their dimensions: Length, 0.53 mm.; breadth, 0.53 mm.; oral sucker, length, 0.10 mm., breadth, 0.10 mm.; ventral sucker, length, 0.14 mm., breadth, 0.18 mm. Measurements of distome from cyst in liver, life: Length, 0.66 mm.; breadth, 0.69 mm.; diameter of oral sucker, 0.14 mm.; ventral sucker, length, 0.18 mm., breadth, 0.22 mm. But few details are shown in the balsam mounts. They are smooth, nearly circular in outline, the cuticle very definitely limited and firm; ventral sucker larger than oral, broader than long, its anterior edge at about middle of the length of the body; oral sucker nearly circular. No pharynx or esophagus seen; intestinal rami appear to be short and to have rather thick walls. There is a deeply stained mass of cells between the ventral sucker and the posterior end, not yet differentiated into genitalia. The parenchyma throughout is finely and uniformly granular. (U.S.N.M. No. 8411.)

ABBREVIATIONS USED ON PLATES

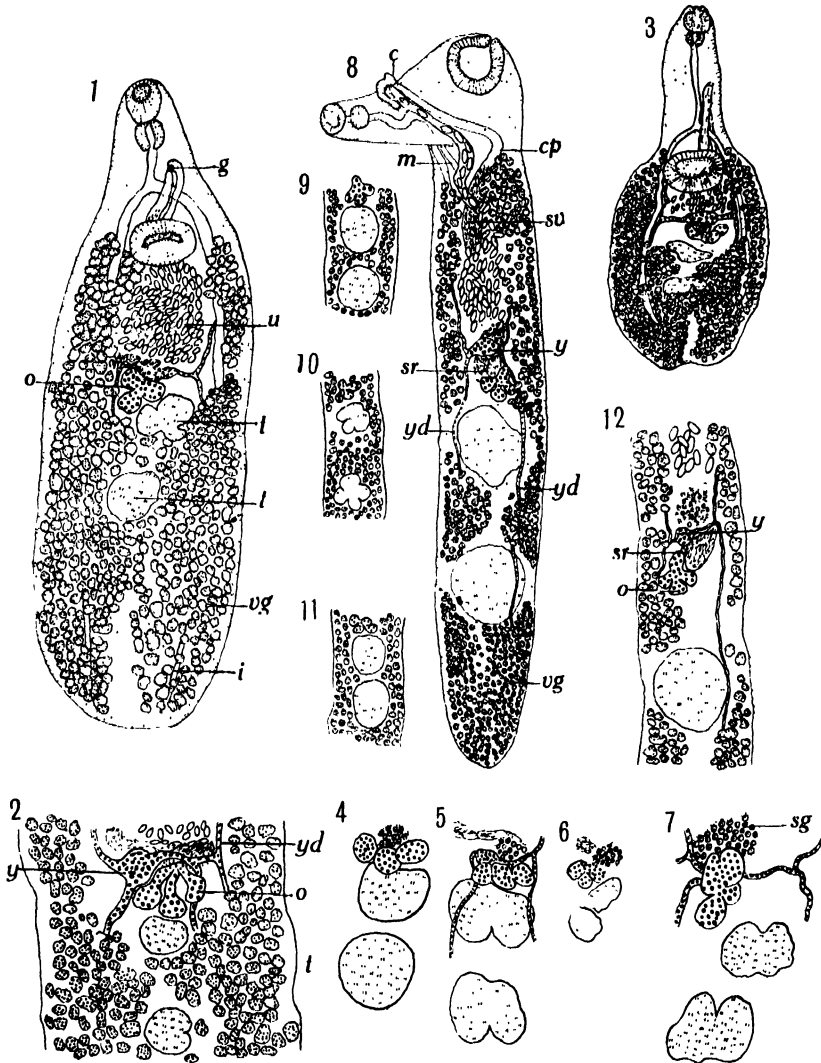
| | | | |
|----------|-------------------------------------|-----------|-------------------------|
| a..... | Acetabulum. | oe..... | Esophagus. |
| c..... | Cirrus. | ph..... | Pharynx. |
| cp..... | Cirrus pouch. | pr..... | Prostate. |
| exp..... | Excretory pore. | sg..... | Shell gland. |
| exv..... | Excretory vessel. | sr..... | Seminal receptacle. |
| ej..... | Ejaculatory duct. | sv..... | Seminal vesicle. |
| g..... | Germinal pore. | sv' | Second seminal vesicle. |
| h..... | Holdfast organ. | t..... | Testis. |
| i..... | Intestine. | u..... | Uterus. |
| l..... | Laurer's canal. | vd..... | Vas deferens. |
| lm..... | Longitudinal muscle. | vg..... | Vitelline gland. |
| m..... | Metratrum. | y..... | Yolk reservoir. |
| o..... | Ovary. | yd..... | Yolk duct. |
| o' | Portion of ovary with mature cells. | | |

Unless otherwise stated all sketches were made with the aid of the camera lucida from balsam mounts.

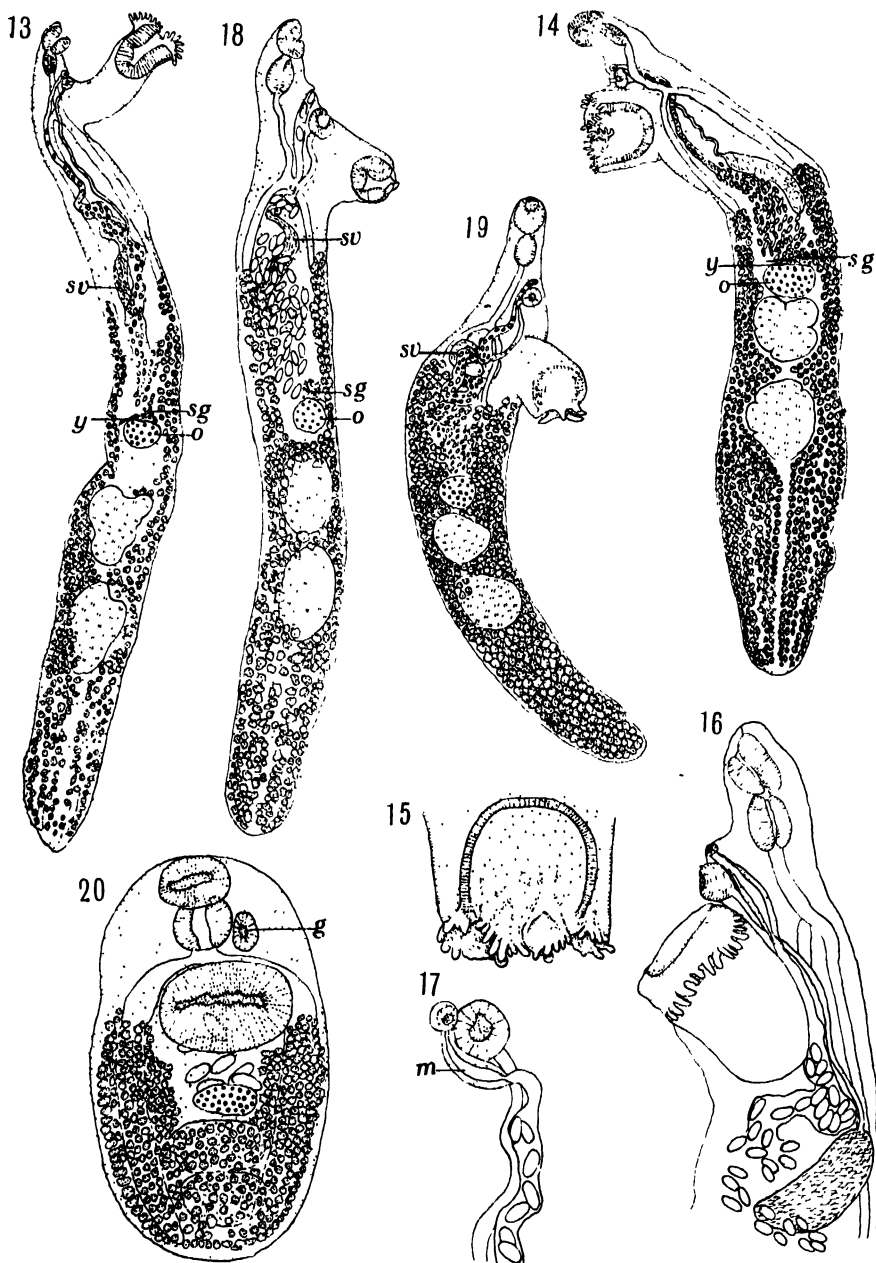
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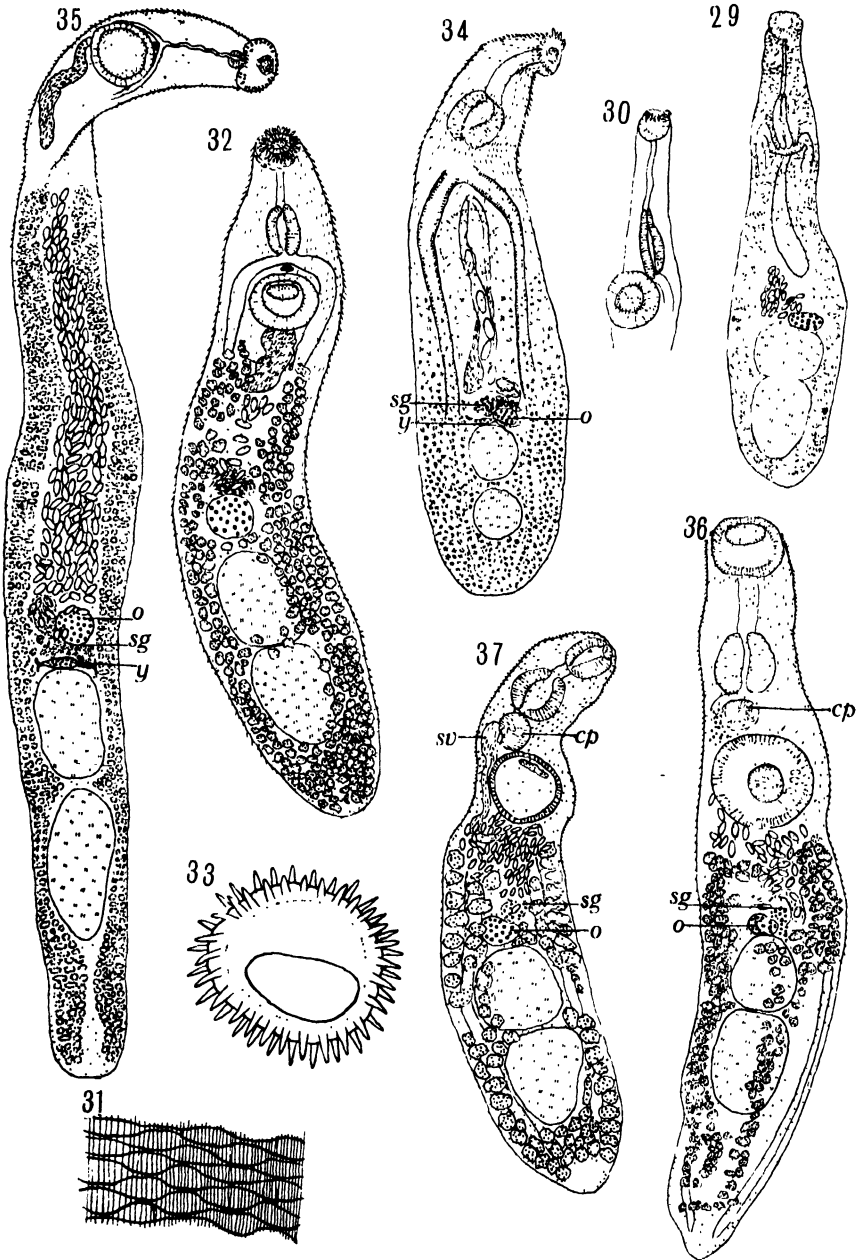
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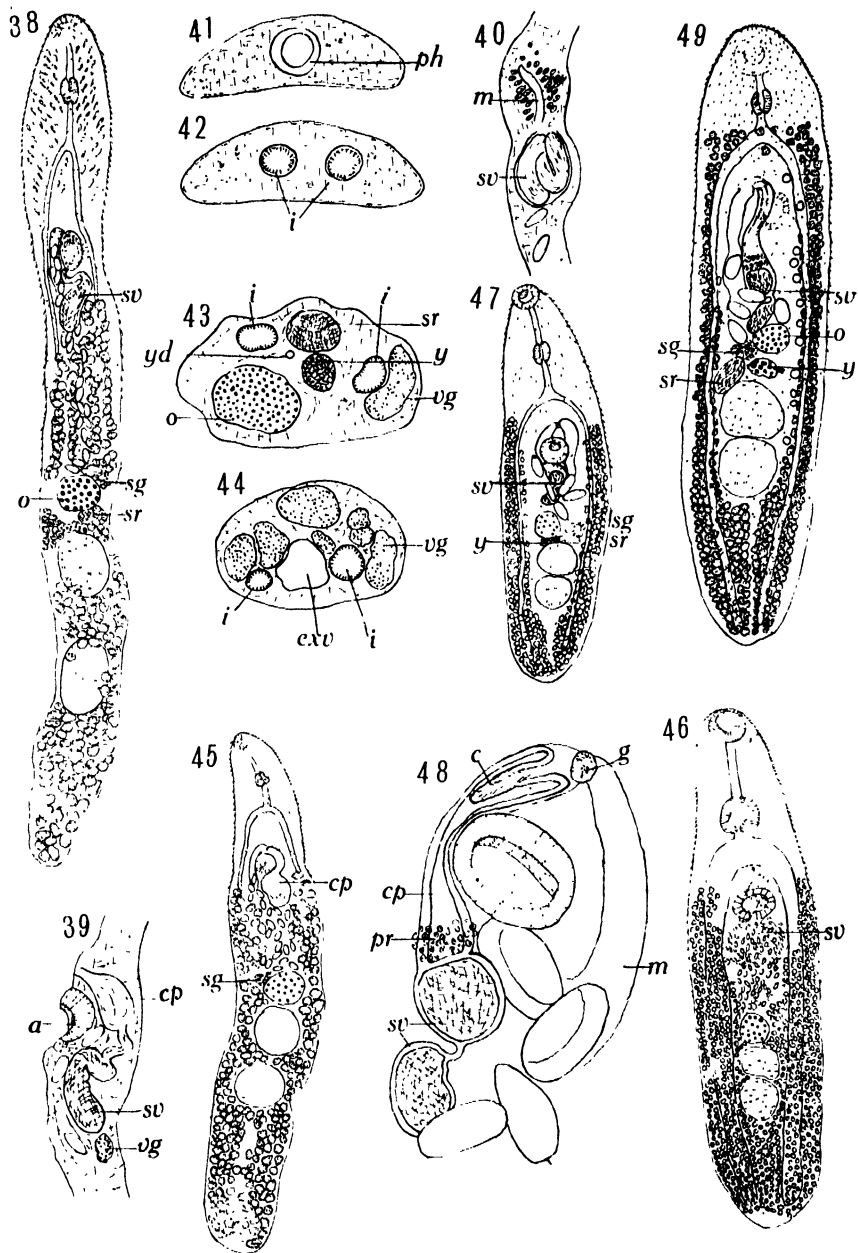
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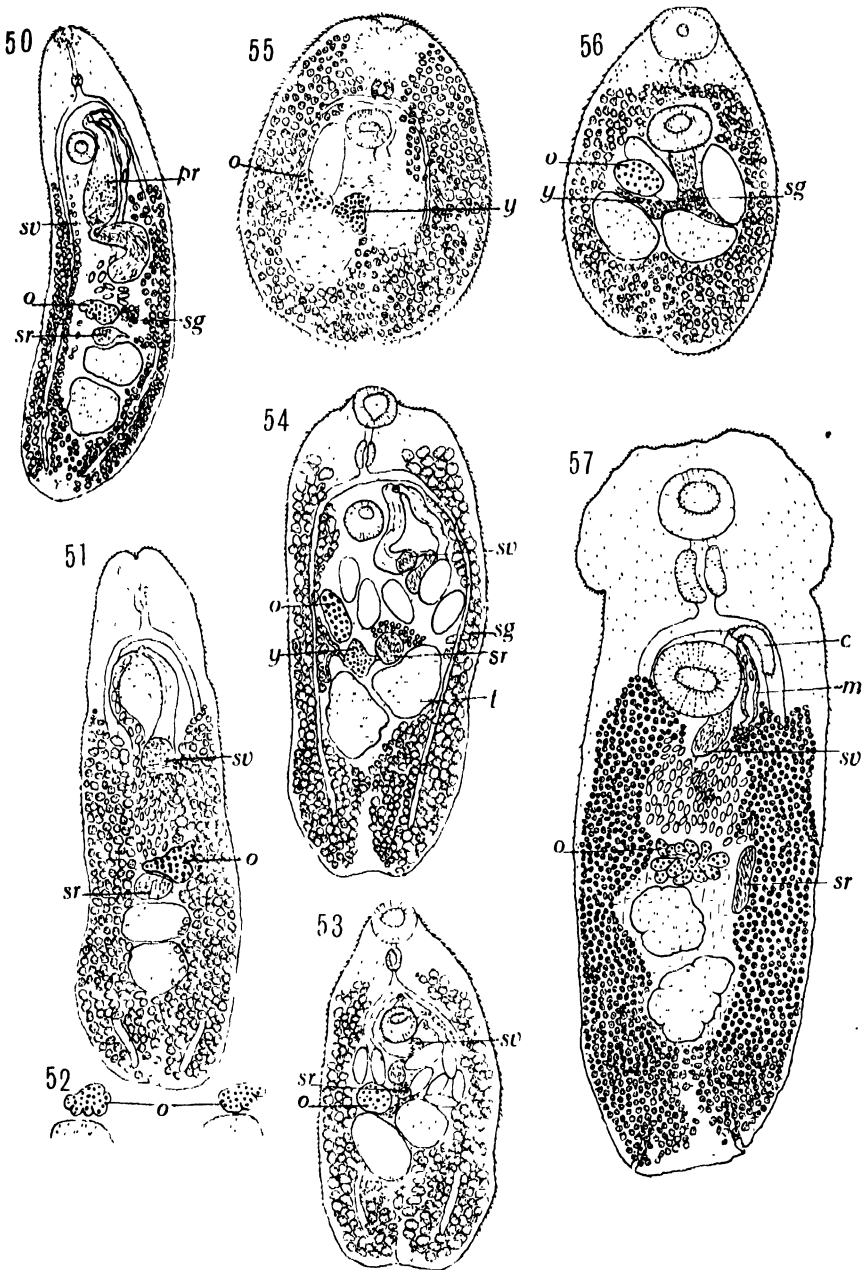
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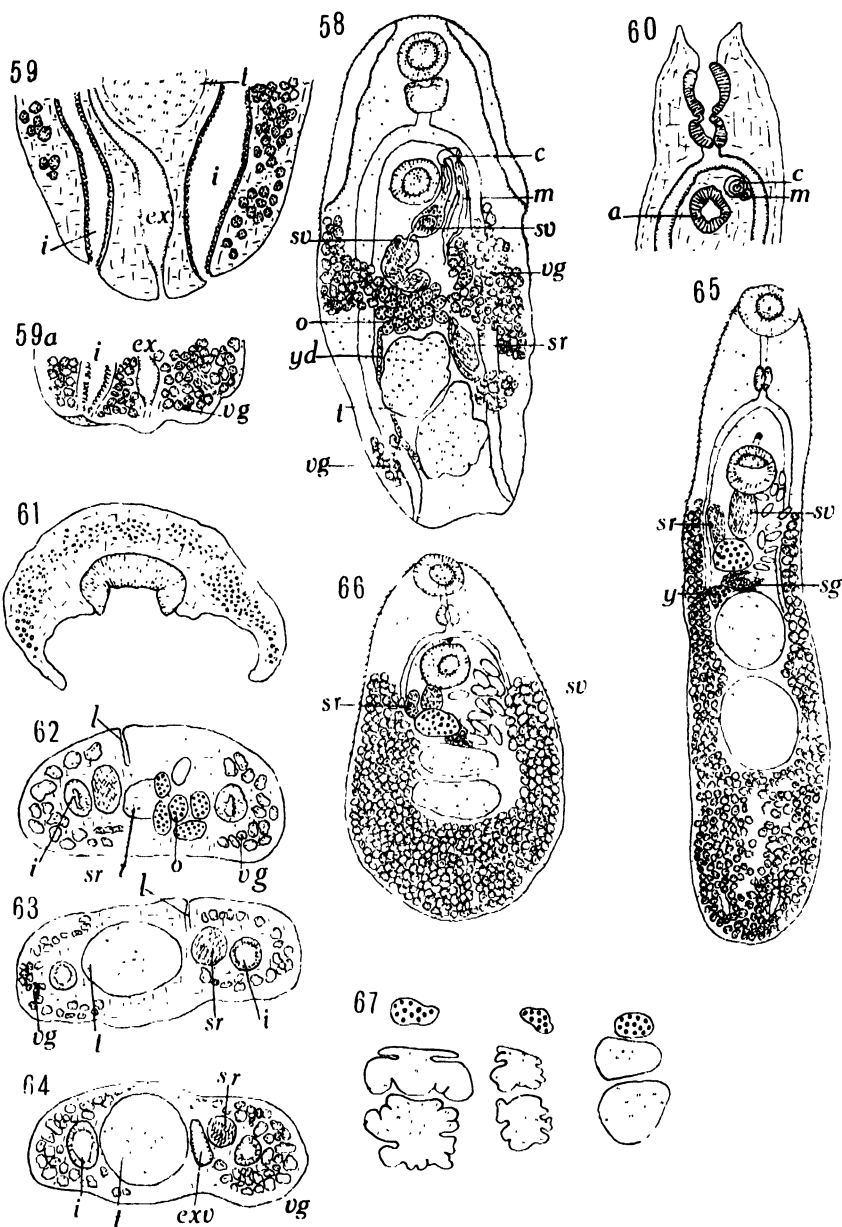
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50-52. *Lepocreadium retrusum*, new species: 50, From *Pneumatophorus grex*, ventral view; 51, dorsal view; 52, ovaries of two showing varieties of lobation.

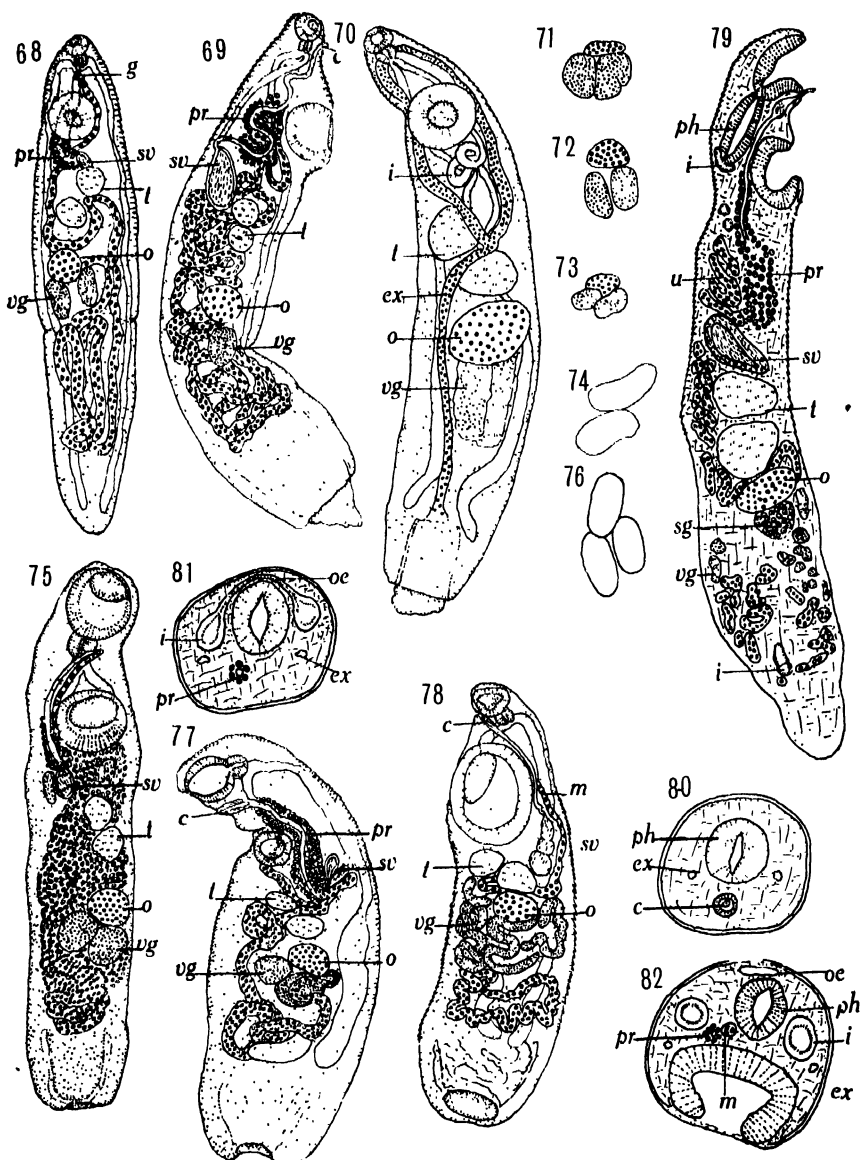
53-56. *Lepocreadium trullaforme*, new species: 53, From *Menticirrhus saxatilis*; 54, from *Morone americana*, somewhat distorted by compression; 55, small distome from young *M. saxatilis*; 56, another from same host.

57. *Bianium plicatum* (Linton): From *Sphaeroides maculatus*, ventral view, lateral margins of neck extended.

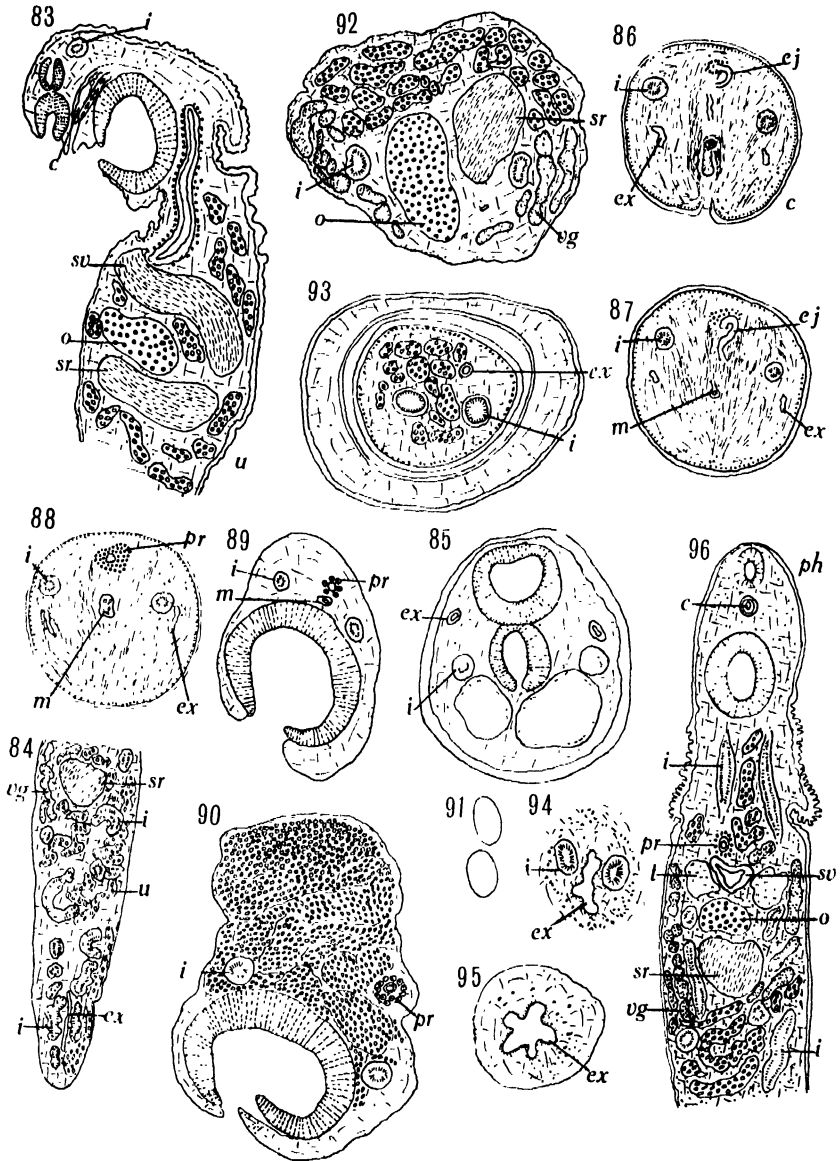


58-64. *Bianium plicatum* (Linton): From *Spherooides maculatus*: 58, Degenerate specimen, vitellaria much reduced, ova few and imperfect; 59, posterior end, frontal section, vitellaria sparse; 59a, posterior end, frontal section, slanting, vitellaria sparse; 60, horizontal section, anterior end; 61, transverse section, anterior end; 62, transverse section at level of posterior border of ovary, testis added from next posterior section; 63, transverse section near level of anterior end of first testis; 64, transverse section at level of first testis showing excretory vessel.

65-67. *Homalometrion pallidum* Stafford: 65, From *Menticirrhus saxatilis*; 66, short variety from same host; 67, ovary and testes from three specimens from *Pseudopleuronectes americanus*.



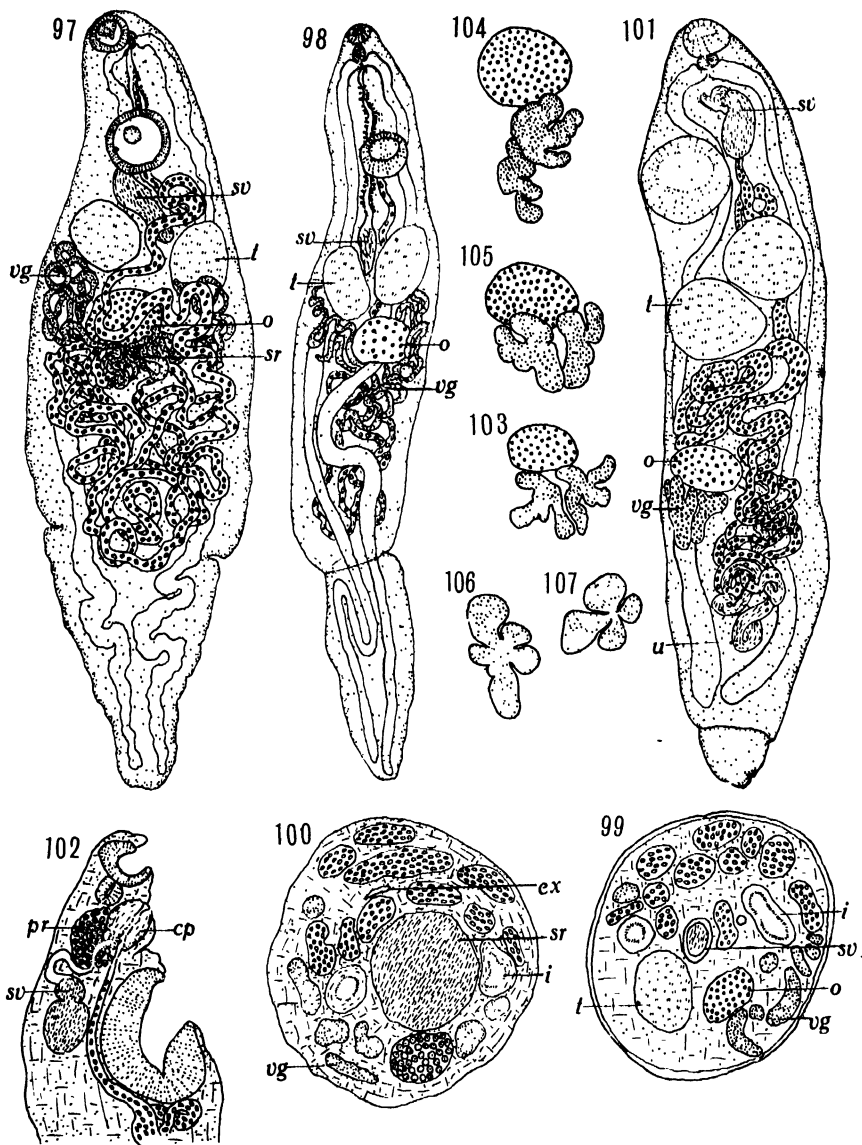
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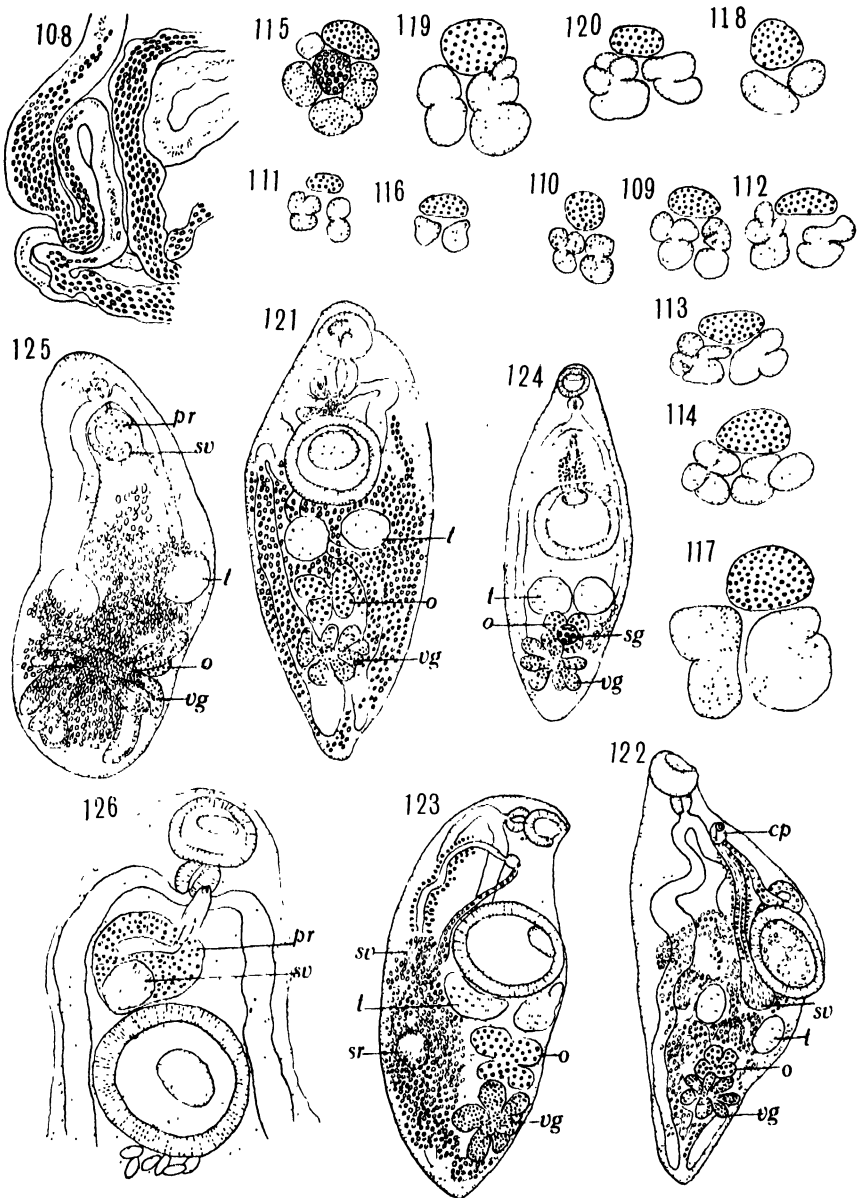
DINURUS PINGUIS, NEW SPECIES.

83-95. From *Anguilla rostrata*: 83, Sagittal section of anterior end; 84, frontal section of posterior end; 85, nearly frontal section of head; 86, cross section of neck at level of genital pore; 87, cross section of neck behind genital pore; 88, cross section of neck short distance back of section shown in fig. 87; 89, cross section of specimen in which ova for most part are confined to postacetabular region; 90, cross section of specimen in which ova are crowded forward dorsal to ventral sucker, section at about same level as fig. 89; 91, ova; 92, cross section behind testes; 93, cross section of retracted appendix; 94, excretory vessel and intestines, from cross section 0.1 mm. from posterior end; 95, cross section 0.06 mm. from posterior end.

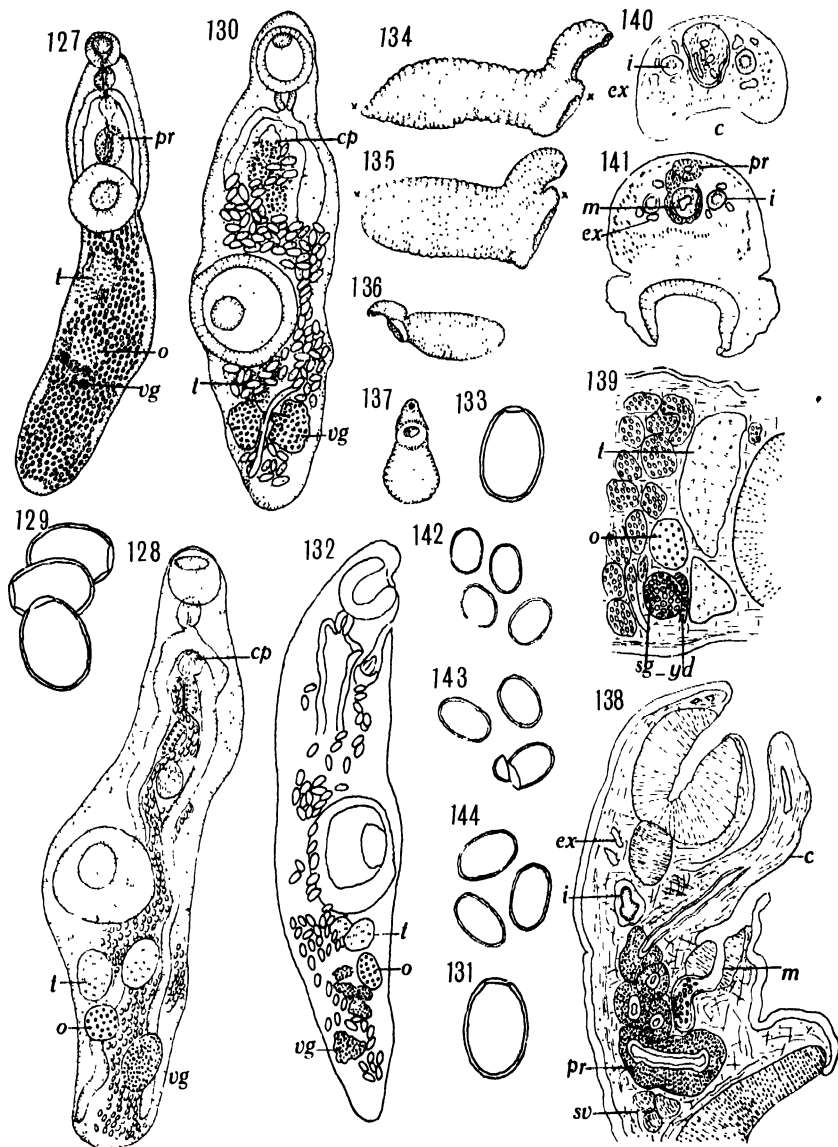
96. From *Menidia notata*: Frontal section, anterior end.



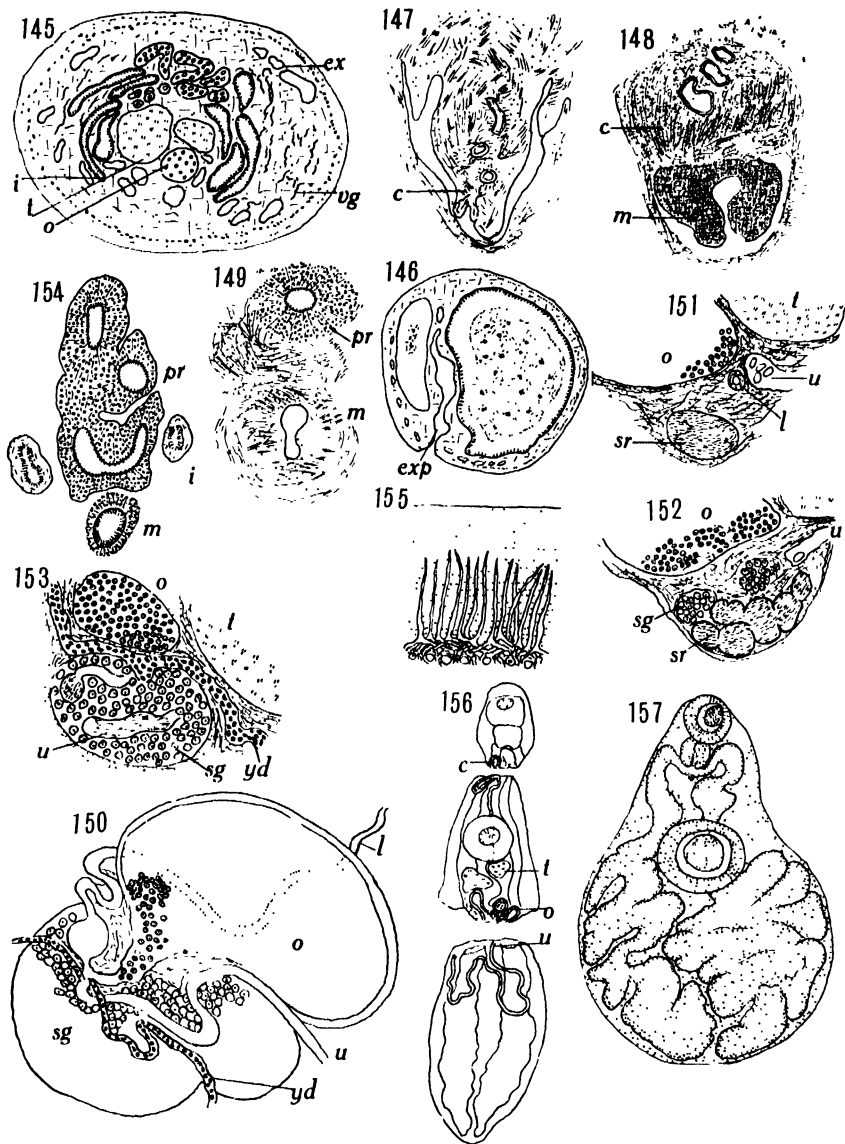
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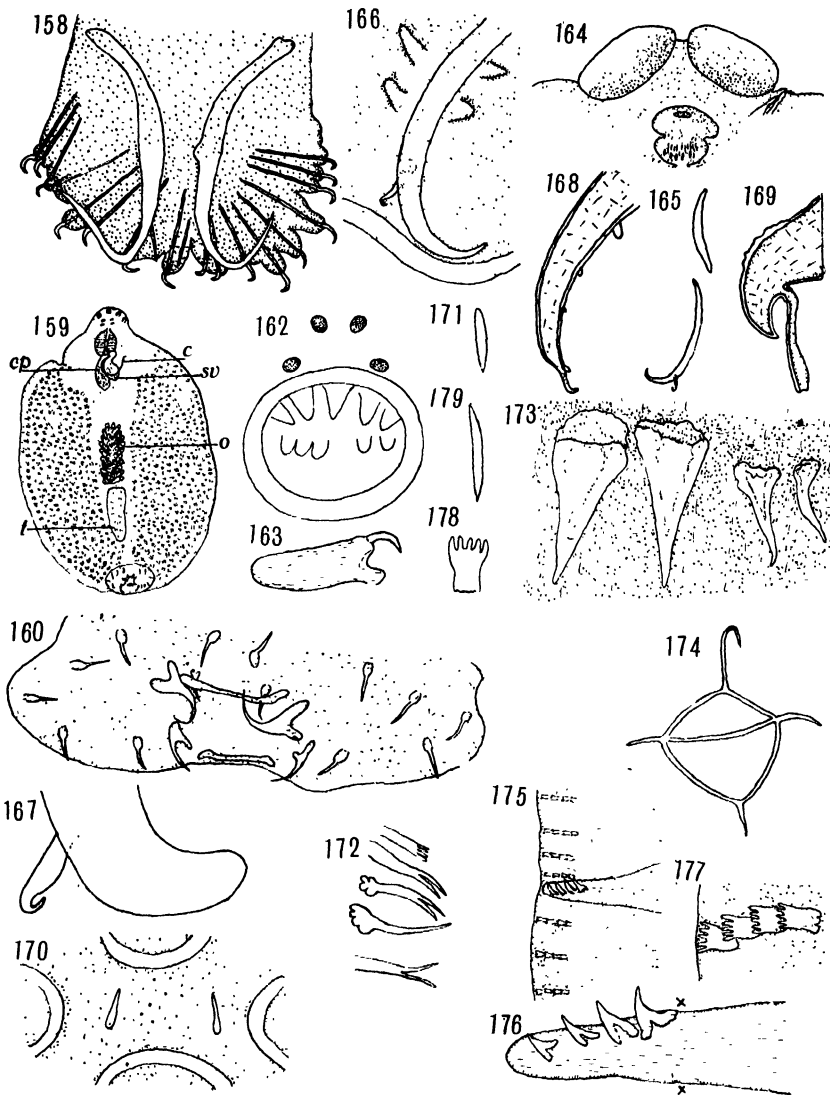
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- 125, 126. *Lecithaster gibbosus* (Rudolphi) from *Stenotomus chrysops*: 125, Dorsal view; 126, ventral view, anterior end.



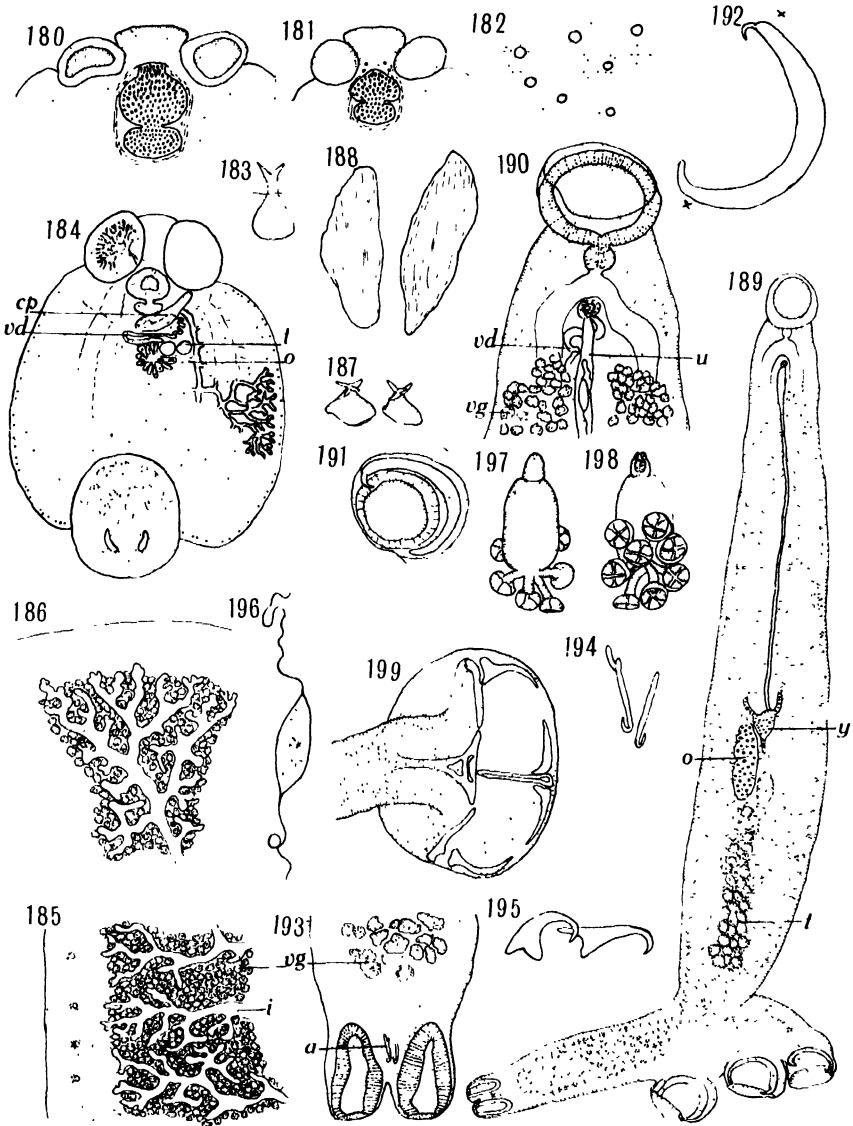
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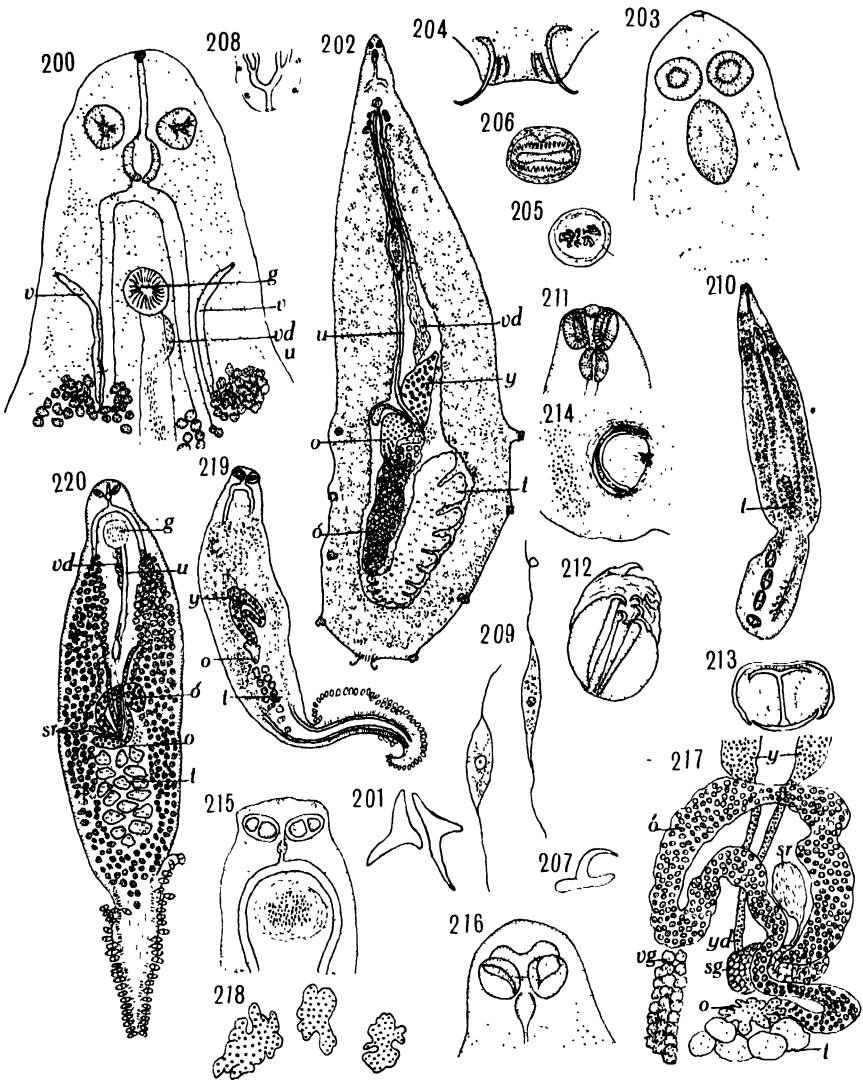
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 162, 163. *Dionchus agassizi* Goto from *Remora remora*: 162, Ventral view of mouth, eye spots showing through; 163, side view of hook, claw restored.
 164-169. *Entobdella hippoglossi* (Müller) from *Hippoglossus hippoglossus*: 164, Anterior end, ventral view; 165, set of hooks on left side; 166, third hook and posterior end of second; 167, third hook and posterior end of second from another specimen; 168, sagittal section of posterior edge of sucker; 169, sagittal section of anterior edge of sucker.
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202-209. *Mazocraeoides georgei* Price from *Pomolobus pseudoharengus*: 202, Ventral view; 203, anterior end, ventral view; 204, posterior end; 205, genital pore; 206, same, life; 207, hook from genital atrium; 208, excretory vessels at posterior end, life; 209, ova.

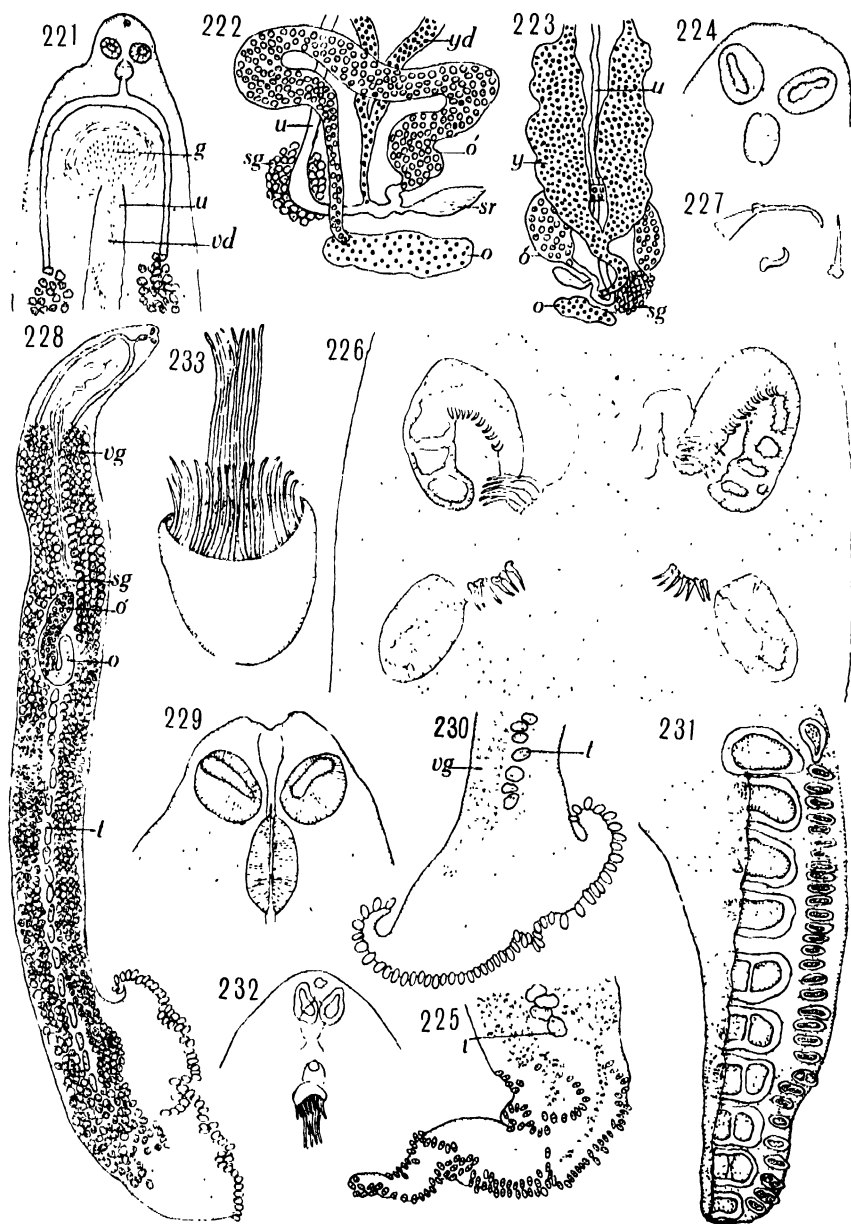
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219. *Microcotyle stenotomi* Goto from *Stenotomus chrysops*: Ventrolateral view.

220. *Microcotyle furcata*, new species, from *Tautoga onitis*: Ventral view.

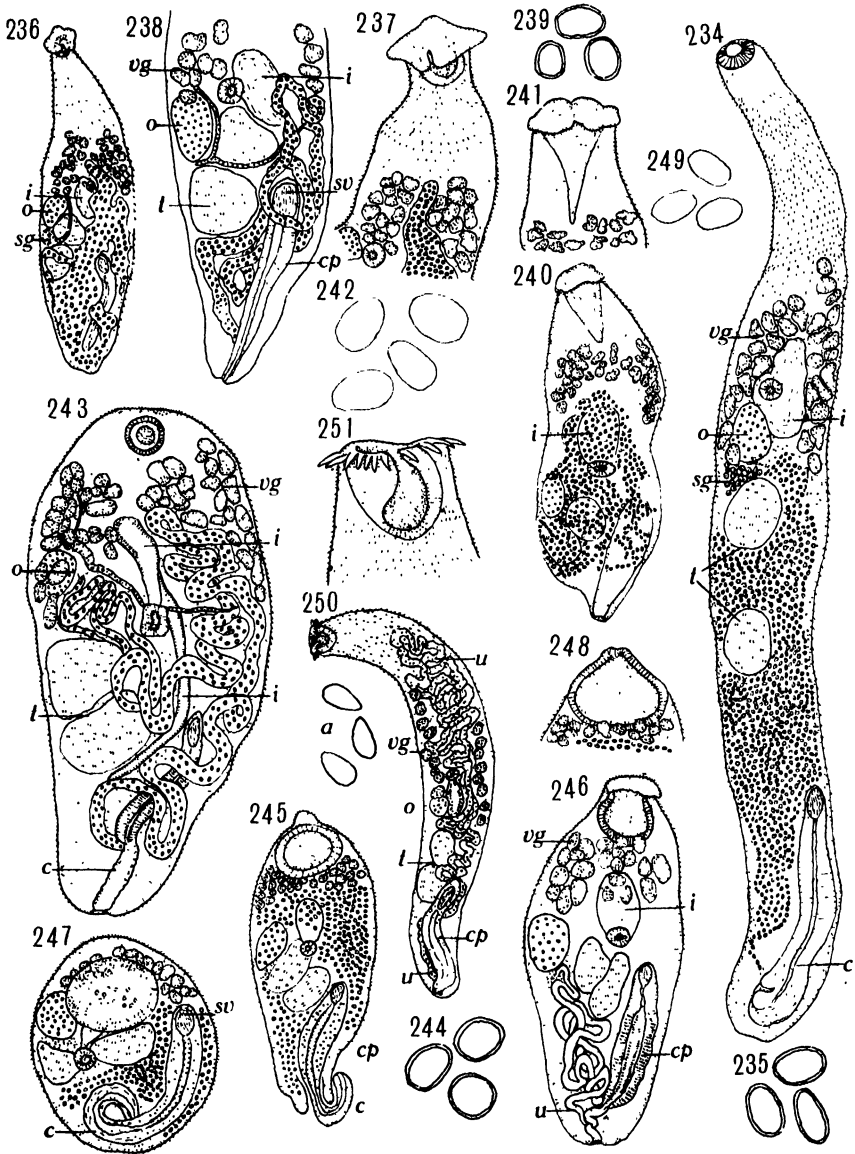


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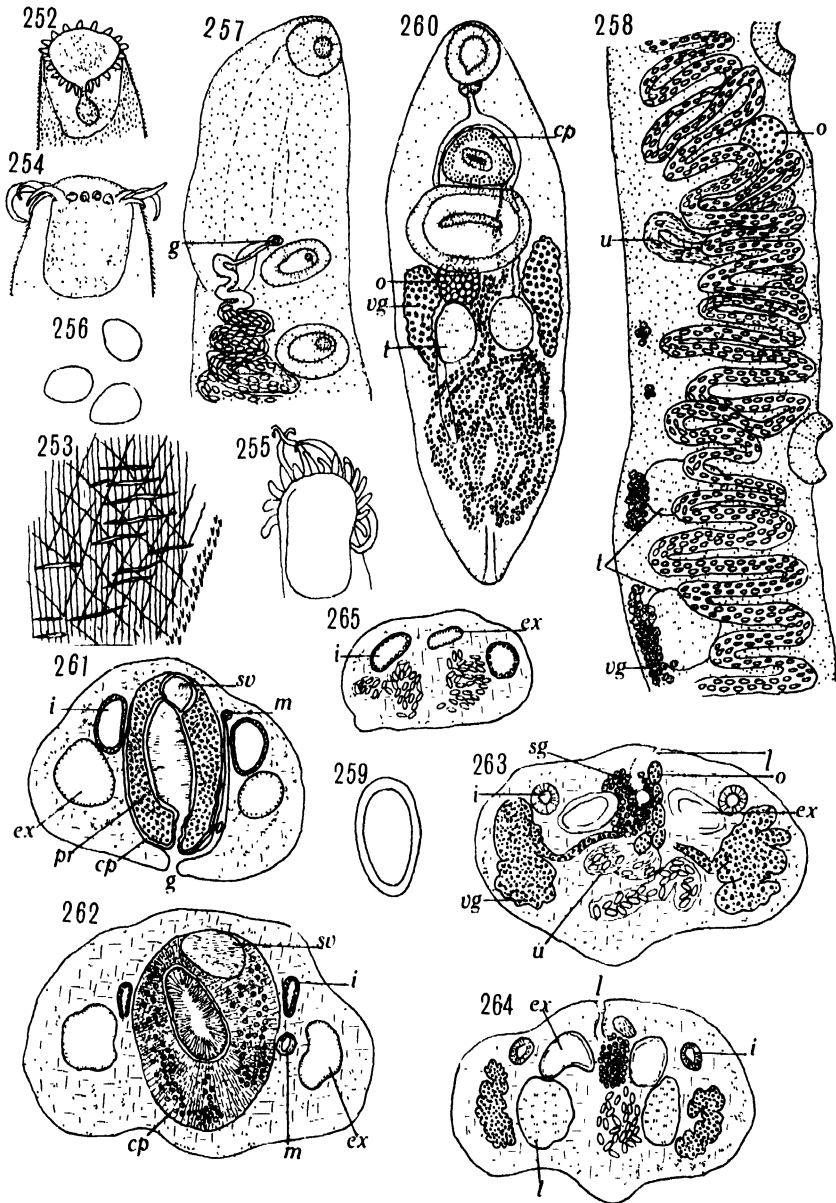
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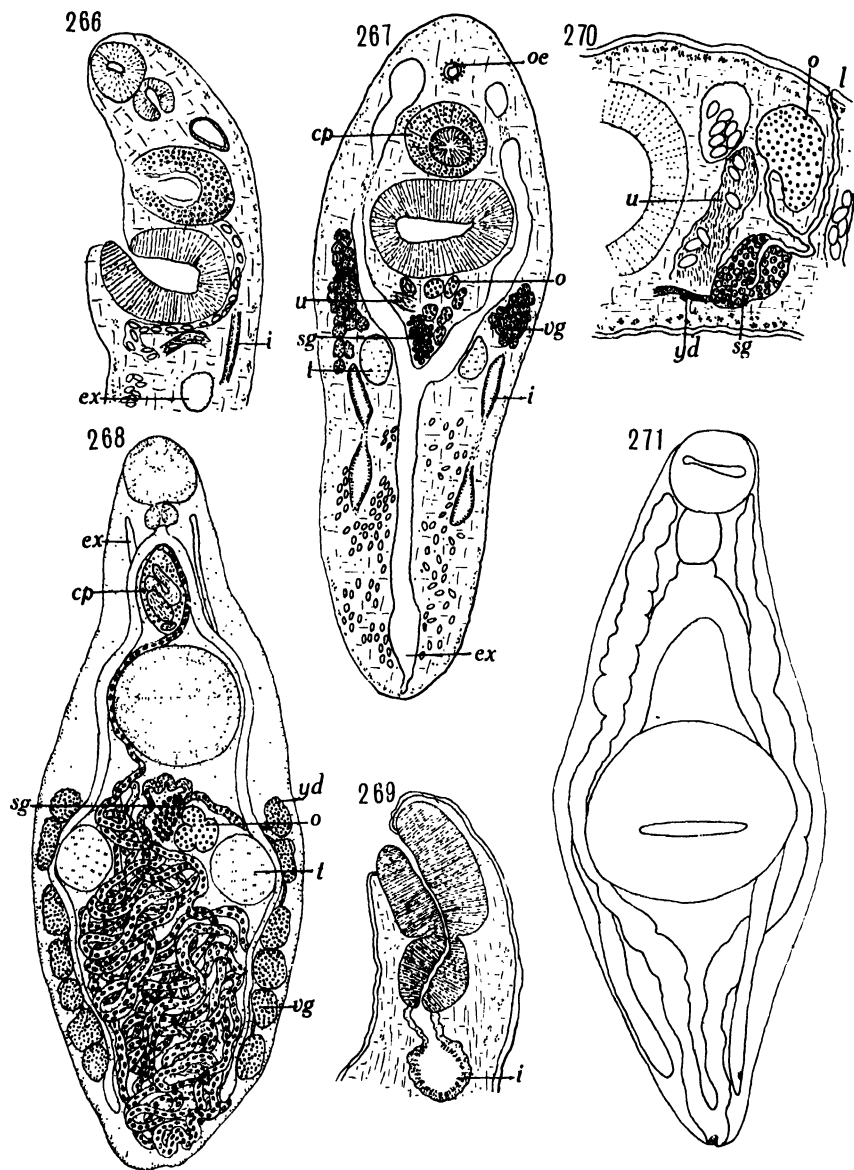
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- 243, 244. *Prosorhynchus ovatus* (Linton) from *Lobotes surinamensis*: 243, Ventral view; 244, ova.
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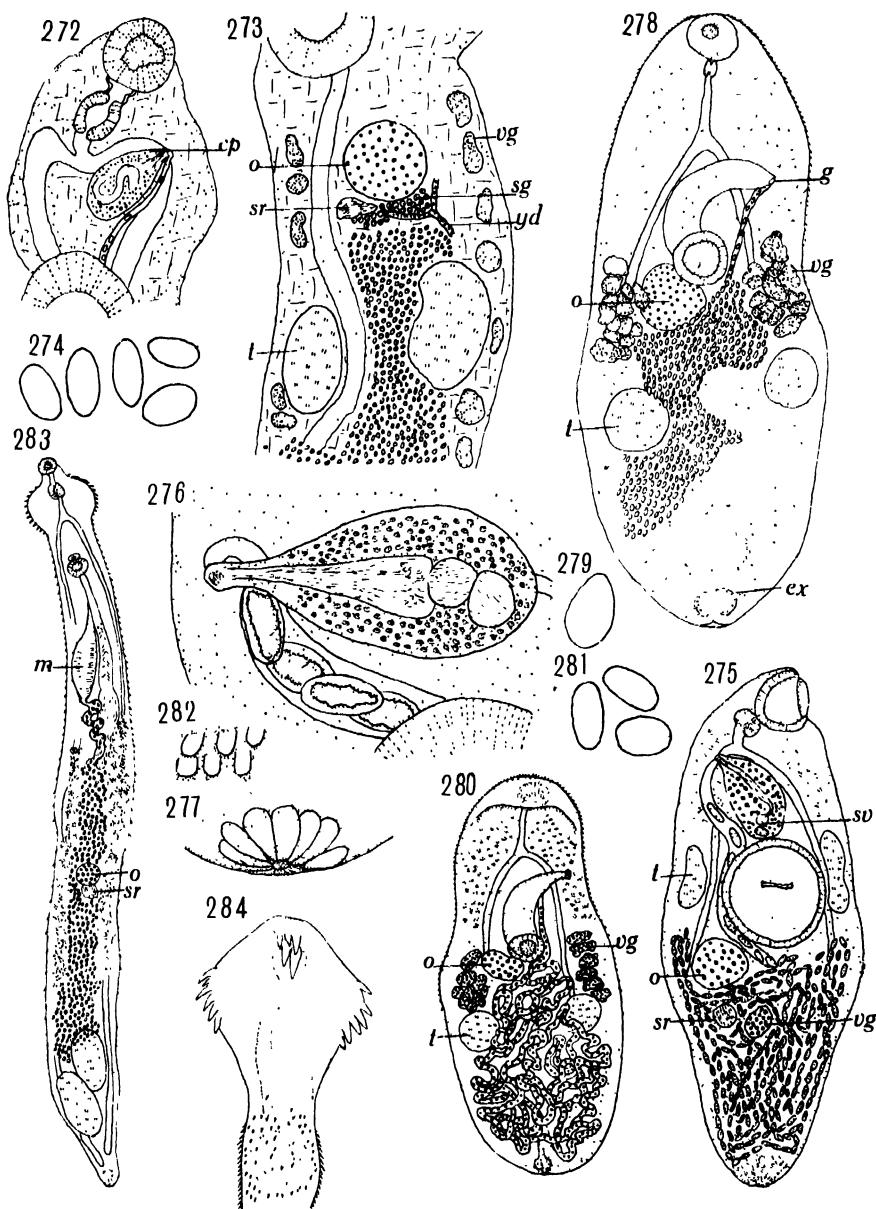


- 252, 253. *Nannoenterum baculum* (Linton) from *Sphyaena borealis*: 252, Anterior end, showing circle of 20 spines; 253, muscle fibers in body wall, glycerin.
- 254–256. *Nannoenterum gorgon* (Linton) from *Seriola lalandi*: 254, Dorsal view of anterior end; 255, dorsal view of another specimen; 256, ova.
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266, 267. *Steringophorus furciger* (Olsson) from *Pseudopleuronectes americanus*: 266, Sagittal section, anterior end; 267, frontal section.

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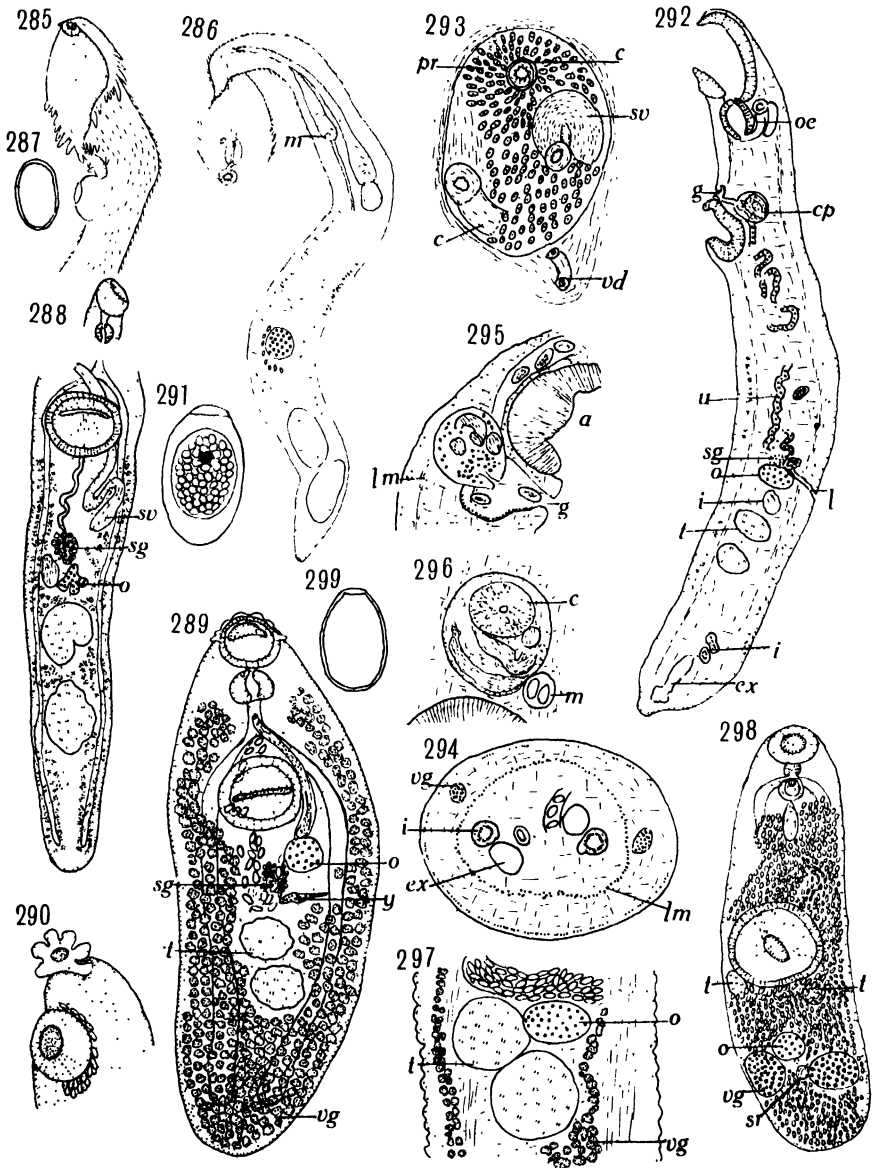
272-274. *Lecithostaphylus nitens* (Linton) from *Tylosurus acus*: 272, Frontal section, anterior end; 273, frontal section, region of ovary and testes; 274, ova.

275-277. *Zoogonoides laevis*, new species, from *Tautoga onitis*: 275, Ventral view; 276, cirrus pouch and metraterm, ventral view, life, ova with ciliated miracidia; 277, excretory pore, life.

278-282. *Steganoderma formosum* Stafford: 278, Ventral view; 279, ovum; 280, ventral view; 281, ova; 282, spines on ventral surface. (278 and 279 from *Paralichthys oblongus*, 280-282 from *Acanthocottus octodecimspinosus*.)

283. *Deropristis inflata* (Molin) from *Anguilla rostrata*: Ventral view.

284. *Deropristis hispida* (Abilgaard) from *Acipenser sturio*: Dorsal view of anterior end.



285-287. *Deropristis hispida* (Abilgaard) from *Acipenser sturio*: 285, Ventrolateral view of head; 286, another, distorted; 287, ovum.

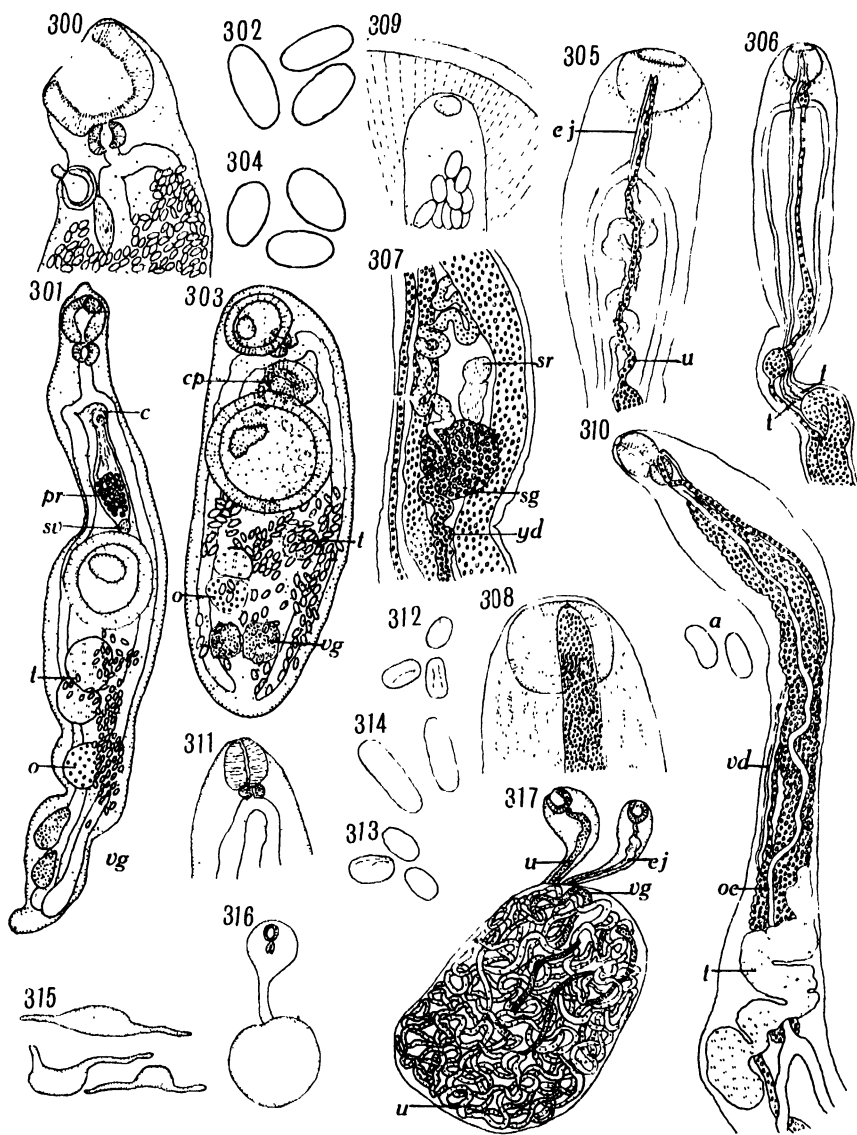
288. *Podocotyle* sp. from *Oncorhynchus tshawytscha*: Broken specimen.

289. *Crepidostomum faronis* (Müller) from *Salvelinus fontinalis*: Ventral view.

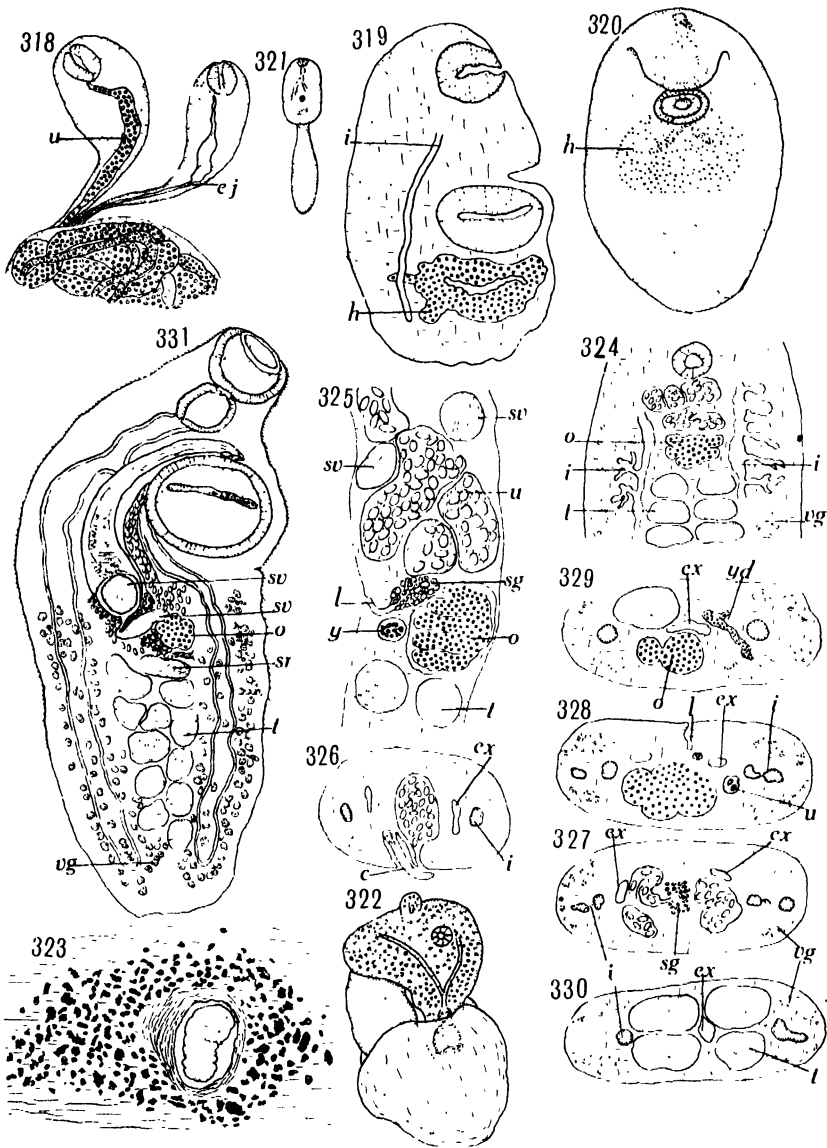
290, 291. *Bunodera nodulosa* (Froelich) from *Perca flavescens*: 290, Ventrolateral view of anterior end, formalin; 291, ovum.

292-297. *Azygia longa* (Leidy): 292, Sagittal section; 293, frontal section of cirrus pouch; 294, cross section, middle of length; 295, sagittal section, region of cirrus pouch; 296, frontal section, cirrus pouch and metraterm; 297, frontal section, region of testes. (292-294 from *Esox niger*, 295 and 296 from *Trichiurus lepturus*, 297 from *Micropterus dolomieu*.)

298, 299. *Genarches mülleri* (Levinsen) from *Cyclopterus lumpus*: 298, Ventral view; 299, ovum.



300. *Genarches mülleri* (Levinsen) from *Cyclopterus lumpus*: Lateral view, anterior end.
 301, 302. *Genarches infirmus*, new species, from *Oncorhynchus tshawytscha*: 301, Ventral view; 302, ova.
 303, 304. *Genarches* sp. from *Oncorhynchus tshawytscha*: 303, Ventral view; 304, ova.
 305-309. *Didymozoon scombri* Taschenberg from *Poronotus triacanthus*: 305, Anterior end, ventral view; 306, same view of another, ejaculatory duct empty; 307, view of region of vicinity of shell gland; 308, anterior end of specimen with metraterm gorged with ova; 309, same, more highly magnified.
 310. *Didymozoon sardae* (G. A. and W. G. MacCallum) from *Sarda sarda*: Anterior end.
 311-314. *Didymozoon* sp.: 311, Anterior end, life; 312-314, ova. (311 and 312 from *Scomber scombrus*, 313 from *Pneumatophorus grex*, 314 from *Seriola zonata*.)
 315-317. *Wedlia bipartita* (Wedl) from *Thunnus secundodorsalis*: 315, Trematodes encysted in pyloric caeca of host, life; 316, small specimen with single head protruding, life; 317, specimen compressed, heads of both male and female protruding.



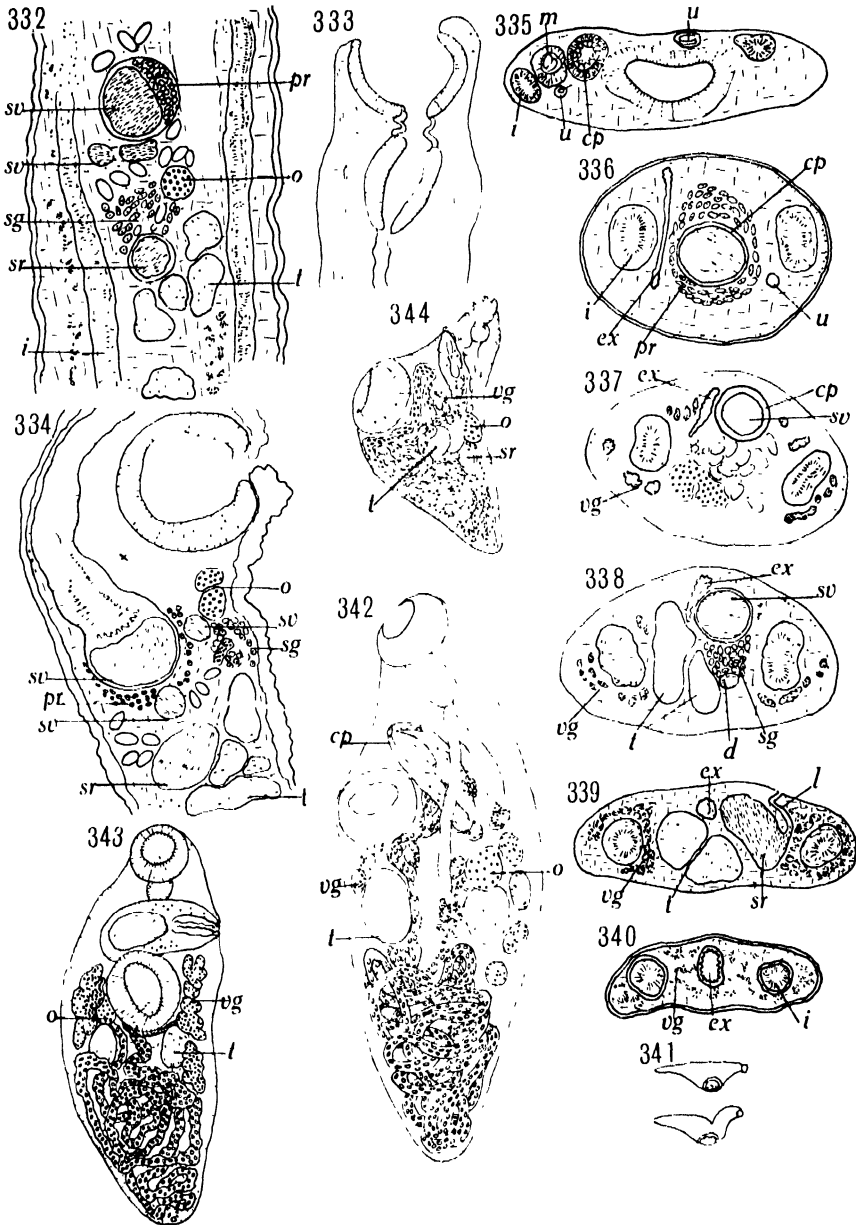
318. *Wedlia bipartita* (Wedl) from *Thunnus secundodorsalis*: Heads of specimens shown in fig. 317, enlarged.

319. *Tetracotyle communis* Hughes from *Stizostedion vitreum*: Longitudinal section.

320-323. *Neascus cuticola* (Nordmann): 320, Ventral view, life, posterior end reflected dorsad; 321, specimen removed from cyst and straightened, life; 322, larva escaping from cyst, life; 323, cyst surrounded by pigment, section. (320 from *Salvelinus fontinalis*, 321-323 from *Micropterus dolomieu*.)

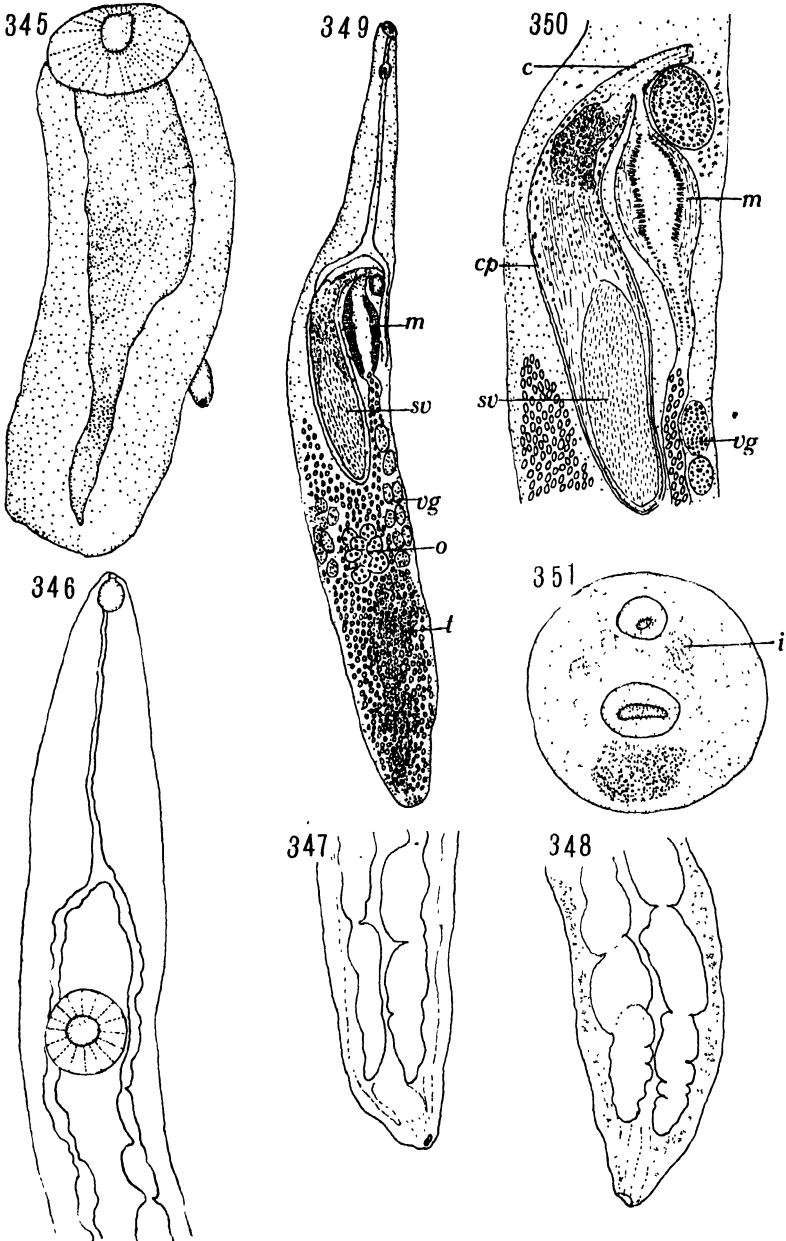
324-330. *Pleorchis americanus* Lühe from *Cynoscion regalis*: 324, Frontal section, region of ovary; 325, sagittal section, region of ovary; 326, cross section at level of genital pore; 327, cross section near level of anterior edge of ovary; 328, fifth section in series back of fig. 327; 329, fifth section in series back of fig. 328; 330, section from series a few sections back of fig. 329.

331. *Gargorchis varians*, new genus and species, from *Ceratacanthus schoepfi*: Ventral view.



332-340. *Gargorchis varians*, new genus and species, from *Ceratacanthus schoepfi*: 332, Frontal section, region of ovary; 333, sagittal section, anterior end; 334, sagittal section, region of seminal receptacle; 335, cross section near anterior end of ventral sucker; 336, cross section, base of cirrus pouch; 337, cross section, level of ovary; 338, cross section, level of first testes; 339, cross section, level of seminal receptacle (tortuous course of Laurer's canal compiled from several sections); 340, cross section near posterior end.

341-344. *Deretrema fusillus* Linton from *Exocoetus volitans*: 341, Characteristic shapes, life; 342, ventrolateral view; 343, ventral view; 344, lateral view.



345. *Monostoma* sp. from *Gadus morrhua*: Ventral view.

346-348. *Distoma fenestratum* Linton: 346, Anterior end of specimen fixed under pressure; 347, posterior end of same specimen; 348, posterior end of specimen showing characteristic constricted intestine. (346 and 347 from *Remora remora*, 348 from *Ammodytes americanus*.)

349, 350. *Distoma* sp. from *Menticirrhus saxatilis*: 349, Ventral view; 350, region of cirrus pouch and metratrem.

351. *Distoma* sp. from *Percopsis omiscomaycus*: Ventral view.



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REPORT ON CERTAIN GROUPS OF NEUROPTEROID INSECTS FROM SZECHWAN, CHINA

By NATHAN BANKS

FOR more than 15 years Dr. D. C. Graham has been sending neuropteroid insects from Szechwan Province, China, to the United States National Museum. In 1928 the late Dr. A. B. Martynov, stopping at Washington, borrowed some of the Trichoptera and in 1931 published a paper on them.¹ Later some of the Plecoptera were lent to Dr. P. W. Claassen and Dr. C. F. Wu. They described some species in 1934.² The great bulk of the material, however, remained unstudied. In 1937 most of that on hand was lent to me, and in 1938 the remainder and some more that had recently arrived. I induced Dr. F. M. Carpenter to work on the family Panorpidae, and his report has recently been issued.³ The present paper deals with all specimens in the collection not considered by these authors. The main part of the collection (including holotypes) is in the National Museum; duplicates, when present, have been retained for the Museum of Comparative Zoology.

Szechwan is extremely rich in many of the groups of neuropteroid insects. Dr. Martynov noted that this fauna resembled that of Tibet more than that of more eastern China. This was due partly to the lack of material from China. In recent years Dr. G. Ulmer has published on large collections of Trichoptera from eastern China; Father

¹ Proc. U. S. Nat. Mus., vol. 79, art. 25, 20 pp., 4 pls., 1931.

² Pekin Nat. Hist. Bull., vol. 9, pp. 112-125, 1934.

³ Proc. Ent. Soc. Washington, vol. 40, No. 9, pp. 267-281, 2 pls., 1938.

Longinos Navás has published on material in the Heude Museum at Shanghai, and the Museum of Comparative Zoology has acquired a large collection from southeastern China and Hainan. With this material it is seen that many of the peculiar genera of western China also occur in the east, although not so abundantly, and in the east there is more infusion of the Malaysian fauna. The species, however, of western China are usually different from those of the eastern, less mountainous part.

It has been extremely interesting to me to discover that there is a true Himalayan fauna, utterly different from the European, from the Mediterranean, and from the American, either North or South, a fauna that spreads south into at least upper India (not to Ceylon), down the Malay Peninsula, and often to some of the Sunda Islands, eastward over China, Burma, Siam, Indochina, and even to Japan and Formosa.

Characteristic genera are *Neopanorpa*, *Limnocentropus*, *Eubasilissa*, *Pseudostenophylax*, *Nothopsyche*, *Stenopsyche*, *Himalopsyche*, *Kamimuria*, *Nogiperla*, *Olaassenia*, *Neochauliodes*, *Neuromus*, *Protohermes*, *Neuronema*, and *Epicanthaclisis*. No insect fauna is entirely endemic as to genera, so here there are representatives of insect faunas characteristic of other regions. The weakness of the Holarctic fauna in Szechwan is greater than one expects from its location, and few of the genera present are represented by more than two or three species. Of the Holarctic genera *Panorpa*, *Rhyacophila*, *Glossosoma*, *Arctopsyche*, *Philopotamus*, *Limnephilus*, *Glyptotaelius*, *Platyphylax*, and *Sialis* occur in both North America and Europe. Of European genera in Szechwan there are *Euroleon*, *Deutoleon*, *Osmylus*, and *Marthamea*, each of few species.

Of American genera in Szechwan (not at present in Europe) there are *Peltoperla*, *Togoperla*, *Potamyia*, *Psilotreta*, *Acroneuria*, and *Halesinus* (near *Neophylax*).

Of Holarctic genera, but practically world wide, there are *Chrysopa*, *Hemerobius*, *Hydropsyche*, and *Goera*.

One European species of *Chrysopa* occurs also in Szechwan, but most of the species are not closely related to European; one is common in Japan. Several of the American genera occur also in Japan. So there is little evidence whether these Holarctic elements in Szechwan came from America or from Europe.

Of typical Mediterranean genera there is no evidence (so far) in Szechwan, although many occur in Turkestan, southern Siberia, northern China, and Japan; such are *Ascalaphus*, *Lopezus*, *Myrmecaelurus*, *Dilar*, and *Raphidia*; the last two genera are doubtless older than the Mediterranean fauna, although now chiefly represented there; both, however, occur in America and elsewhere.

Various genera now typically tropical are present in Szechwan; these, however, are commoner in eastern China. These genera are *Nothochrysa*, *Ankylopteryx*, *Neoperla*, *Spilosmylus*, *Dipseudopsis*, *Notanatomica*, *Indophanes*, *Polymorphanisus*, and *Hydromanicus*, represented by only one or two species each.

In spite of the infusion of elements from other regions, the Himalayan element is dominant in specimens and species. Although there are here recorded 107 species, and a few others have been described from Szechwan, this is probably less than half of the number that will eventually be found in this rich province. Thirty-six species are described as new.

Family PERLIDAE

Genus CLAASSENIA Wu

CLAASSENIA SEMIBRACHYPTERA Wu and Claassen

Several from between Kinting and Suifu, June 26 to July 1, 1,500 feet; Shin Kai Si, Mount Omei, July 17-30, 4,400 feet; and Kaiting, 1,500 feet.

Genus ACRONEURIA Pictet

ACRONEURIA GRAHAMI Wu and Claassen

Three females: One from Kuanshien, September 12, 3,000 feet; one from Yellow Dragon Temple near Songpan, July 25-28, 11,000 to 14,000 feet; and one from near Tsao Ting, July 12, Yunnan.

The ventral plate is produced slightly, almost angularly in the middle.

ACRONEURIA YIUI Wu

One male from Mount Omei has the papillae on the ninth tergite in a continuous area, those on the tenth in two groups; the button on last sternite is moderately small and transverse, but the pointed processes are directed upward, not toward each other as Wu states.

Genus KAMIMURIA Klapálek

KAMIMURIA TAOI Wu

From Chengtu, May 1, 1,700 feet, Shin Kai Si, Mount Omei, 4,000 feet, and also Pei Bay, June (G. Liu).

KAMIMURIA SIMPLEX Chu

From Mount Omei, in July, described from Szechwan.

KAMIMURIA FULVESCENS Klapálek

One from Yachow to Muping, June 23-25, 2,000 to 5,000 feet; one from O-Er, 26 miles north of Li Fan; and one (crushed) from 9 miles southwest of Tatsienlu, June 25-27. The processes are very small and poorly developed. Wu * misspells it *flavescens*.

* Pekin Nat. Hist. Bull., vol. 11, p. 183, 1936.

KAMIMURIA JEANNELI Wu

Two females of this large species from near Suifu, May-June. Described from Hangchow.

KAMIMURIA TIENMUSHANENSIS Wu

From Kuanshien; described from Tienmushan.

Genus TYLOPYGE Klapálek**TYLOPYGE KLAPALEKI Wu and Claassen**

One from O-Er, near Li Fan, August 6-16, 9,000 feet, and one from Lim Ngai Si, near Kuanshien, September 20-30, 3,500 feet.

Genus TOGOPERLA Klapálek**TOGOPERLA GRAHAMI, new species****PLATE 27, FIGURES 2, 5**

Head mostly black, the lateral tubercles and raised lines in front of anterior ocellus yellowish, and some pale back of eyes and ocelli; antennae and palpi dark brown; pronotum dull black, mesonotum dark in front, rest and abdomen pale yellowish, but latter somewhat darker at tip; venter wholly pale; legs pale on basal half or two-thirds of femora, rest black, a yellowish streak under the hind tibiae.

Wings brown, subcostal area scarcely darker, costal area yellowish. Venation much as in *T. perpicta* and *T. limbata*, the cross vein in hindwing as usual; in forewings, however, the radial sector arises more basally than usual, very much before end of the first anal vein.

The male genitalia somewhat like *T. valvulata*, but the inner pad of processes not nearly so prominent, and the sixth and seventh segments show no group of spinules, the sixth and eighth with some rather short hair (not nearly so long as in *T. perpicta*).

Length of forewing, 22 mm.

One from Lin Ngai Si, near Kuanshien, Sept. 20, 3,500 feet (holotype); and one from Kuanshien, August 13, 1937 (through Parish). The leg marks are similar to *T. bifoveolata* from Tonkin, but the genitalia are different. Holotype, U.S.N.M. No. 53139. Paratype in M.C.Z.

Genus MARTHAMEA Klapálek**MARTHAMEA ARMATA, new species****PLATE 27, FIGURES 4, 6**

Head largely dull black, but a broad yellow stripe each side from base of antenna up between eyes and ocelli; basal joint of antennae dark, beyond pale for some distance then gradually becoming darker;

palpi black; pronotum wholly black; mesonotum mostly black, but some pale each side on scutellum; metanotum black in front and middle, elsewhere pale; abdomen pale tawny above and below, also cerci; sternum pale; legs largely pale, but hindlegs dark toward tips of femora and above on the tibiae; wings pale gray, veins brown, costal veins yellow. Head moderately broad, eyes large, ocelli form an isosceles triangle, hind ocelli plainly nearer each other than to eyes; pronotum much broader than long, somewhat narrowed behind, a rather broad median furrow with the two ridges, lateral rugae fairly large.

Wings moderately slender; usually two branches to the radial sector beyond anastomosis, about five costal cross veins beyond end of subcosta, first anal without curve, second only slightly curved, first anal ends before origin of radial sector, latter rather far out, and about as near to anastomosis as to first median cross vein. Male genitalia very prominent; the fifth segment much produced behind in a forked lobe, each lobe with spinules, the upper branch of the process is very long, horizontal, with a large hook at inner base, the inner edge toward tip has several spinelike teeth, the first two rather large; this process has many long, fine, erect hairs on inner side, the lower branch of the process is slender and smooth and reaches fully to the forked lobe of seventh segment.

Length of forewing, 14 mm.; width, 4 mm.

One male from Chengtu, May 10-11, 1,700 ft. In general appearance it is similar to *M. vitripennis*. Holotype, U.S.N.M. No. 53140. *Paragnetina multispinosa*, lately described by Wu,⁶ is very similar, but the process is differently armed.

Genus NOGIPERLA Okamoto

NOGIPERLA CHIANGI, new species

PLATE 27, FIGURES 3, 8, 9

Pale brownish yellow; abdomen rather more yellow; wings pale gray, veins brownish; apical half of cercal spine black; legs pale yellowish, unmarked. The ocelli large and widely separated, the eyes rather large, larger than in *fraterna*; pronotum broader behind than in front, the corners broadly rounded, posterior margin concave; forewings long and slender, about 15 costal cross veins, four or five beyond end of subcosta, about five median and five to seven cubital cross veins, radial sector forked once, the pedicel nearly or fully as long as fork, median is also forked once beyond the anastomosis, branches from anal cell wide apart at base. In hindwings five to eight costals and four or five beyond; radial sector and medius

⁶ Peking Nat. Hist. Bull., vol. 13, p. 65, 1938.

forked as in forewing; in both wings the cross veins from radius to medius are almost in line.

In the male the uplifted penultimate ventral segment shows at base a rounded lobe.

The female resembles the male, but the cerci are normal, basal joint not elongated nor with spine; the ventral plate of female is extremely large and covers the next segment, the tip entire.

Length of forewing, 10 mm.; width, 3 mm.

From Liu Ngai Si, near Kuanshien, September 20-30, 3,500 feet (holotype); Beh Luh Din, August 7-25, 6,000 feet; and Mu Sang Tsai, 10 miles northwest of Weichow, July 2-6, 8,000 to 10,000 feet. Holotype, U.S.N.M. No. 53141. Paratypes in U.S.N.M. and M.C.Z.

In the wholly pale body and legs it is like *N. fraterna*; from *fraterna* it differs in the elongate cercal joint longer, the black cercal spine, in the small rounded piece at base of penultimate ventral segment, etc.

The three known species are from Japan, Formosa, and Malacca.

Genus NEOPERLA Needham

NEOPERLA MINOR Chu

Several from Mount Omei in July and August. Described from Hangchow.

NEOPERLA TINGWASHANENSIS Wu

One from Kuanshien, July 18-20, 5,200 feet.

Genus PARAGNETINA Klapálek

PARAGNETINA INDENTATA Wu

Two specimens, rather small, appear to belong to this species, one from Kuanshien and one from Si Gi Pin, August 5-9, 6,000 to 7,000 feet. Also from Pei Bay, June (G. Liu).

Genus PELTOPERLA Needham

PELTOPERLA SINENSIS Wu and Claassen

One from 9 miles southwest of Tatsienlu, June 25-27, 8,500 feet.

Family SIALIDAE

The genera of Sialidae known to occur in China, or some from nearby, can be separated as follows:

1. No ocelli; pronotum twice as broad as long; fourth tarsal joint with plainly bilobed tip (subfamily Sialinae)----- 2
- With ocelli; pronotum about as long as broad; fourth tarsal joint scarcely, if at all, bilobed (subfamily Corydallinae)----- 3

2. Radial sector toward tip with several branches from upper side to margin----- *Sialis*
 Radial sector without such branches, simply cross veins to radius----- *Indosialis*
3. First anal vein of forewings forks twice; more than three radial cross veins (tribe *Hermesini*)----- 4
 First anal forks but once----- 5
4. Ocelli small, round; anterior ocellus not transverse; wings heavily marked or all dark----- *Hermes*
 Ocelli large, elongate; anterior ocellus plainly transverse; wings wholly pale----- *Protohermes*
5. A distinct tooth on margin of head back of eyes; usually at least four radial cross veins (tribe *Corydalini*)----- 6
 No such tooth on head; usually but three radial cross veins (tribe *Chauliadini*)----- 7
6. A spine or tooth on upper side of head each side; clypeus very deeply indented in middle; mandibles very large; some costals crossed----- *Acanthacorydalis*
 No such spines on head; clypeus only slightly, if at all, emarginate; mandibles not so elongate; costals usually not connected-- *Neuromus*
7. Ocelli very small, laterals more than four diameters apart; antennae in both sexes pectinate; wings without prominent marks----- *Ctenochauliodes*
 Ocelli large, laterals not over three diameters apart----- 8
8. Antennae of male pectinate, of female not at all; wings with spots, at least one in costal area before stigma----- *Neochauliodes*
 Antennae of neither sex pectinate, in male a little serrate; wings without definite marks----- *Parachauliodes*

Genus *SIALIS* Latreille

SIALIS SINENSIS, new species

PLATE 29, FIGURE 52

Body black, legs and antennae also; wings fumose, front pair darker, almost black near base; head with the usual two submedian stripes behind, not narrowed posteriorly, each side with two rows of three rounded spots, and outside of these seven more or less elongate spots. Surface of head not evenly punctate or granulose but covered with many short, irregular ridges. The transverse suture above antennae very distinct, in middle projecting angularly behind but no impressed line or groove from this to the submedian elongate spots. Pronotum a little more than twice as broad as long, a little broader behind than in front, surface densely punctate.

Forewings have the costal area but little swollen, less than in many species, 10 or 11 costal cross veins; the cross vein from subcosta to radius but little more than its length from origin of radial sector (usually much farther); the three radial cross veins at about equal distances apart and from base of radial sector, the latter arises plainly beyond the oblique cross vein between medius and cubitus.

Tip of male abdomen projecting above, and below with a large central opening; below this is a broad, oblique area.

Length of forewing, female, 12 mm.; male, 10 mm.

From Kuanshien, Szechwan.

Holotype male, U. S. N. M. No. 53142. Paratypes in U. S. N. M. and M. C. Z.

Genus ACANTHACORYDALIS Weele

ACANTHACORYDALIS ORIENTALIS McLachlan

Two specimens from Kuanshien, Szechwan, 1,800 to 3,500 feet. I have one from Ichang, Hupei. In all three the median pale stripe of pronotum is nearly of the same width throughout, only a trifle wider in anterior part, but not so much as in Van der Weele's figure of *A. kolbei* from Omei Shan, or so wide as his diagram of *A. orientalis* from McLachlan's photograph; and the photograph does not show it so wide. On the sides of these specimens are several elongate pale stripes, very similar to Van der Weele's figure of *A. kolbei*; moreover McLachlan says "somewhat irregular longitudinal lines, forming ill-defined bands on either side." Therefore I consider that *A. kolbei* is a synonym of *A. orientalis*. McLachlan's type was from Chia-ting-Fu, western China.

Genus NEUROMUS Rambur

NEUROMUS IGNOBILIS Navás

Several from Shin Kai Si, Mount Omei, July; near Mount Wei, July 24 to August 4, 2,000 to 8,000 feet. Described from Kuanshien. Very little different from *N. latratus* McLachlan, wings more fulvous than *latratus*, and latter is often darker toward tip.

NEUROMUS MCLACHLANI Weele

One from Long Tsi Shien, Mount Omei, about 3,000 feet. Mount Omei is the type locality.

Genus PROTOHERMES Weele

PROTOHERMES DAVIDI Weele

Three from Szechwan, August 1928. It is the largest species in the genus; *P. horni* Navás is evidently the same form.

PROTOHERMES FLAVIPENNIS Navás

One from Pei Bay, June (Gaines Liu), Szechwan.

PROTOHERMES COSTALIS Walker

One from between Mount Omei and Mount Wa, July 24 to August 4, 2,000 to 8,000 feet. Described from North China, also known from Formosa.

PROTOHERMES XANTHODES Navás

Many from Chengtu, May 17–22, 1,700 feet, and near Suifu, May to June. May be the same as *P. rubidus* Stitz, which has the head and pronotum greatly darkened.

Genus NEOCHAULIODES Weele**NEOCHAULIODES SINENSIS Walker**

Three from Suifu, May 10, 1,000 feet, also Peking. Widely distributed in China.

NEOCHAULIODES OCCIDENTALIS Weele

One from Suifu, August 1928; a large and more maculate form of *N. sinensis*.

NEOCHAULIODES FRATERNUS McLachlan

One near Tsaotong, July 12, Yunnan, and one Szechwan, August 1928.

Genus CTENOCHAULIODES Weele**CTENOCHAULIODES FRIEDRICHI Navás**

From Szechwan (no definite locality), and from Mount Omei, 11,000 feet, July. I have it from Kuanshien, May.

Family MICROMIIDAE (Hemerobiidae)

The genera of Micromiidae known to me from China and adjoining areas can be tabulated as follows:

- | | |
|---|--------------------|
| 1. Forewings with a recurrent vein at base, costal area broadened near base..... | 6 |
| Forewings without recurrent vein, costal area more narrow at base..... | 2 |
| 2. Medius and cubitus in basal part well separated; but one series of gradates beyond middle of wing; but two radial sectors; wings very slender..... | <i>Lachobiella</i> |
| Medius and cubitus running close together in basal part; two series of gradates; three or more radial sectors..... | 3 |
| 3. Medius not forked before the cross vein to cubitus; wings very slender; nearly all gradates well separated..... | <i>Nenus</i> |
| Medius forked before the cross vein to cubitus; wing less slender, often many gradates more close to each other..... | 4 |
| 4. Some of costal cross veins near base connected to each other.... | <i>Phlebiomus</i> |
| Rarely any of costal cross veins connected..... | 5 |
| 5. But four radial sectors; gradates much separated..... | <i>Micromus</i> |
| More than four radial sectors; gradates nearer each other.... | <i>Eumicromus</i> |
| 6. Forewing with but one, a median, series of gradates..... | 7 |
| Forewing with an outer series also..... | 8 |

7. Subcosta and radius as far separated as the veins behind them,
and a connecting cross vein----- **Annandalia**
Subcosta and radius close to each other, almost touching in basal
part----- **Notiobiella**
8. No outer gradates in hindwing----- **Symphorobius**
An outer gradate series in hindwing----- 9
9. First anal vein forked near middle, and the fork running
parallel to vein----- 10
First anal vein with only short branches to margin or if forked,
then the fork diverges----- 12
10. Tip of wing plainly falcate; at least five radial sectors; costal
area very broad and some of the cross veins connected----- **Drepanacra**
Tip of wing not falcate----- 11
11. Four or five radial sectors, last with four or more branches;
cubitus runs far out, ending near outer margin; besides the
usual two there is a subbasal series of gradates----- **Neuronema**
More than five radial sectors, last with but three branches; cubi-
tus ends on hind margin; but two series of gradates----- **Megalomus**
12. Tip of wings falcate; but three radial sectors; first anal with
divergent fork----- **Allemerobius**
Tip of wing not at all falcate----- 13
13. In hindwing origin of first radial sector and fork of medius
are opposite; in forewing the cross vein from medius to cubi-
tus is as long as the cross vein behind it----- **Boriomyia**
In hindwing fork of medius is plainly beyond origin of first
radial sector; in forewing the cross vein from medius to cubi-
tus is plainly shorter than the cross vein behind it.

Hemerobius (or *Mucropalpus*)

Several subgenera may be recognized, as *Indomicromus* for those species of *Nenus* with a broader wing, and gradates less separated; *Schneiderobius* for those *Hemerobius* with the cross vein between radius and medius out near or even a little on the first radial sector.

Genus NEURONEMA McLachlan

NEURONEMA LAMINATA Tjeder

PLATE 28, FIGURES 26, 28

Several from Beh Luh Dun, July 30 to August 25; Mu Sang Tsai, 10 miles northwest of Weichow, July 2; O-Er, 26 miles north of Li Fan, August 6, 9,000 feet; Tsi Kong, August 11, 13,000 feet; Hai Tsi Ping, near Tatsienlu, August 5, 13,000 feet; and 9 miles southwest of Tatsienlu, June 2-7, 8,500 to 13,000 feet. Described from Kansu. The male genitalia, from side, show the superior lobe not nearly so greatly swollen as in *N. deltoides*, but much higher than long, and with the wart about its width from the upper margin. The slender piece below is inwardly curved and its tip has stout black spines; in one specimen there projects from above base of this piece two slender upcurved blades.

NEURONEMA SIMILIS, new species

PLATE 28, FIGURES 27, 30

In general similar to *N. sinensis* Tjeder, but the dark basal part of wing is not so dark, and the pale apical part is more broken by marks, the outer gradates are brown, except lower three, in both sexes; male genitalia very different.

Face pale, with a few faint dark marks, a dark brown spot over base of each antenna; antenna pale, but inner side of basal joint brown; pronotum brown, with a pale stripe through the middle, mesonotum and metanotum largely brown; abdomen above and below paler brown; legs pale, front femora dark above, front and mid tibiae with the usual dark streaks.

Forewings marked much as the photograph of *N. sinensis*; gradates mostly brown, but a few in each row usually pale; in hindwings outer gradates dark, inner row hyaline, longitudinal veins mostly brownish, a faint brown cloud on hind margin beyond end of anal vein.

In forewings four radial sectors, the fourth with six or seven branches; at inner gradates only two veins between the hyaline line and the medius, about 6 inner gradates, 10 in middle series, and 14 in outer row.

In the male the superior plate is much longer and less high than in other species, the wart is near the lower edge, and beyond it and above it are two slightly swollen areas (dotted lines in figure), the lower piece is not so long as in *laminata* and has a black tooth at end; the inferior piece (ninth sternite) is much slenderer than in *laminata*.

Length of forewing, male, 12 mm.; female, 13 mm.

Several from Yellow Dragon Temple, near Songpan, July 20, 12,000 to 14,000 feet.

Holotype, U. S. N. M. No. 53143. Paratypes in U. S. N. M. and M. C. Z.

ALLEMEROBIOUS, new genus

In appearance like *Hemerobius*, with recurrent vein, but rather narrow costal area; the fork of median vein is scarcely bent down, so that the cross vein to cubitus is nearly as long as the one behind it; it differs from both *Boriomyia* and *Hemerobius* in having the tip of wing falcate, the outer margin being broadly, evenly concave, three radial sectors (in genotype), two series of gradates, the first anal vein with long fork.

ALLEMEROBIOUS FLAVEOLUS, new species**PLATE 28, FIGURE 32**

Body, legs, antennae, and wings distinctly pale yellowish, forewing with a brown shade along hind margin, most prominent along the concave outer border; some of the gradates faintly, but rather broadly margined with pale brown; and near tip some veins have faint shadings of brown on each side (as usual in *Hemerobius*); along hind and outer margin there is a brown dot at end of each veinlet, and one between; hindwing faintly yellowish, veins yellow, unmarked.

Almost all costal cross veins are forked for fully one-third way out; six inner and seven outer gradates, fairly evenly spaced except that in outer row the one next to the top is much beyond the others, and in the inner row the lower one is beyond the next. The lower branch of the second fork of the third radial sector ends in the acute tip of wing; a cross vein well before the first radial sector and just before the forking of medius; the first anal forks a little beyond middle. In hindwing four gradates in inner row, and six in outer row, next to top much beyond the others.

Length of forewing, 10 mm.; width, 4.5 mm.

Two females, one from Gieh Yin Temple, Mount Omei, August 10-11, 9,500 feet (holotype), and one from O-Er, 26 miles north of Li Fan, August 16-21, 10,000 feet; also from Weichow, 65 miles north of Chengtu, August 15; and Shin Kai Si, Mount Omei, August 20, 4,000 to 6,000 feet. Holotype, U. S. N. M. No. 53144. Paratypes in U.S.N.M. and M.C.Z.

Genus *HEMEROBIOUS* Linnaeus***HEMEROBIOUS CHIANGI*, new species****PLATE 28, FIGURE 33**

Face pale yellowish, shining, cheeks brown; vertex brownish on sides, pale in middle; antennae dark brown, gradually fading to pale at tip, inner and lower sides of basal joint pale; pronotum brown on sides, broadly pale in middle, rest of thorax above pale, slightly darker on sides; abdomen mostly brown; legs pale, hind tibiae not swollen.

Forewings with mostly pale venation, most of cross veins dark, three more prominent brown spots along the cubitus, stigma scarcely marked; in hindwings the veins mostly pale, but radius and sector toward tip are brown.

Wings moderately slender, tips hardly acute. Forewings with three radial sectors, the third with four branches; fork of medius

is just behind origin of first radial sector, the first branch of cubitus arises much beyond forking of medius; the cross vein from medius to radius is a short distance out on the first radial sector, and is hyaline; the medius at the cross vein to cubitus is scarcely bent, so that the cross vein is almost as long as that from cubitus to anal vein; about six inner gradates, and seven or eight outer ones, the most posterior of inner series is plainly beyond the next.

Male appendages slender, inner edge with an erect, slender spine beyond middle, but about twice its length before the tip.

Length of forewing, 9 mm.; width, 3 mm.

From Tsi King 13,000 feet, August 11, one male, holotype, U. S. N. M. No. 53145. A female from near Washan, 6,000 feet, July 26, probably belongs here, venation about the same, but the antennae are wholly pale. This species is related to *H. poppei* Petersen, which Tjeder records from Kansu. *H. poppei* is said to have pale antennae, darker at tip. Their figures show the spine heavier and nearer to the tip. Petersen speaks of the cylindrical hindtibiae. There are, however, differences in their figures, and there may be two species. The basal venation is much as in *H. pini* and *H. nitidulus* for which Krüger makes *Reuterobius* and *Schneiderobius*, and it may be these form a subgenus.

HEMEROBIUS GRAHAMI, new species

Face shining, very dark brown, cheeks also, vertex very dark, last joint of palpi dark, antennae brown on outer side and above of basal joint, below pale, other joints pale, with broad rings or brown at tips; pronotum very dark brown, a pale median line, a little widened behind, rest of thorax above also dark brown, no pale spots, except faintly in middle front of mesonotum, hair on thorax very long; abdomen also dark brown above and below. Forewings rather heavily marked with brown; cross veins brown, longitudinal veins mostly brown, with short hyaline spots, the brown extended each side on membrane, larger brown spots along median and cubitus, over the first and last connecting veins, and halfway along over the second and third branches of the cubitus; margin of wing faintly, but broadly, infusate, a few hyaline spots along outer and hind margin, but much separated, stigma not especially marked; in hindwings veins mostly brown, stigma more prominent.

Wings rather long, apex rounded, cross vein from radius to median is near base, three radial sectors, equally separated, third forked three times; first cross vein back to radius farther than usual beyond second fork; seven inner gradates, last two close together, but last is a little beyond the other; seven outer gradates, rather widely separate; in hindwing five gradates in outer and two in inner row.

Forewing, 9.2 mm. long; 3.6 mm. wide.

One female from Suifu, April. Holotype, U.S.N.M. No. 53146.

HEMEROBIUS BISPINUS, new species

PLATE 28, FIGURES 25, 29

Face pale yellowish, a brown spot each side under eye and continued down on clypeus; antennae pale; pronotum pale in middle, with broad brown stripe each side, rest of notum pale, with dark at base of wings; abdomen pale brownish above, paler below; legs pale, unspotted, hind tibiae swollen.

Forewings pale, veins mostly pale, sparsely marked with brown, gradates brown, a small brown mark over cross vein from medius to cubitus and at bases of radial sectors, margin dark with a few pale spots; hindwings with pale veins and brownish gradates, a faint dark mark at end of anal.

Wings of moderate breadth, venation much as in *humuli*, lower gradate of inner series plainly beyond next; six inner, seven outer gradates. The male genitalia are more like *H. ferox* and *H. spinigerus*, but the tip of the superior branch is pointed beneath, and the two spinelike processes above are slenderer than in *H. ferox*, the lower part is longer and slenderer than in *H. ferox*.

Length of forewing, male, 7.5 mm.; female, 10 mm.

Holotype, U. S. N. M. No. 53147, from Szechwan, March 11-21, 1933, altitude 2,000 feet; paratypes from Beh Luh Din, 30 miles north of Chengtu, April 1-15. The larger female from Beh Luh Din does not seem to differ.

The three species from Szechwan are separable as follows:

- | | |
|---|----------|
| 1. In forewings the cross vein from medius to radius is close to or out a bit on the first radial sector----- | chiangi |
| In forewings this cross vein is near the base of wing, far from base of radial sector----- | 2 |
| 2. Face pale, dark under eyes----- | bispinus |
| Face almost wholly dark----- | grahami |

Family PSYCHOPSIDAE

Genus BALMES Navás

BALMES TERRISSINUS Navás

Many specimens south of Suifu, Yunnan border, April, and from Chengtu, May.

Family CHRYSOPIDAE (Nothochrysidæ)

The genera of Chrysopidae known from China and nearby areas can be separated by the following table:

1. Costal area extremely broad from the very base..... **Ankylopteryx**
Costal area at first very narrow, then gradually widening..... 2
2. Hind tibia not more than three times as long as hind tarsus;
third cubital cell divided longitudinally..... **Nothochrysa**
Hind tibia more than three times as long as hind tarsus..... 3
3. Cubitus of forewing running out to apical fifth of wing; cubital
area broader than the postcubital area..... **Prochrysopa**
Cubitus bends down to hind margin before apical third of wing..... 4
4. Third cubital cell longitudinally divided..... **Leucochrysa**
Third cubital cell obliquely divided, the vein ending on upper
margin of cell..... 5
5. But two rows of gradate veinlets..... **Chrysopa**
More than two rows, or irregular..... 6
6. Cross veins many, and not in rows..... **Tumeochrysa**
Cross veins in three rows..... **Chrysopidia**

Chrysoplecta Navás, 1910, is the same as *Tumeochrysa* Needham, 1909.

Cintameva Navás was made for species having cross veins in the costal area of stigma; this character is somewhat variable; but the group includes *C. perla* Linnaeus, which is the type of *Chrysopa*, so falls.

Nineta Navás was made for *Chrysopa vittata*, on account of the rather more prominent cerci in the male; this is also a variable character. The type species in the hindwing has the radial sector separate from the median near base, tho very close; other species placed in *Nineta* have them partly united; at best it is a subgenus.

Genus NOTHOCHRYSA McLachlan

NOTHOCHRYSA AEQUALIS Walker

Three from Suifu, 1,000 to 2,000 feet.

Genus ANKYLOPTERYX Brauer

ANKYLOPTERYX 8-PUNCTATA Fabricius

One from Beh Luh Din, September 20–28, 6,000 feet.

Genus CHRYSOPIDIA Navás

CHRYSOPIDIA REGULATA Navás

PLATE 27, FIGURE 17

Two from near Washan, July 26, 6,000 feet, and Shih Men Kan, Kweichow, July 28.

The discoidal cell is small, but the vein ends plainly beyond the cross vein, eight or nine cubitals beyond; stigma with cross veins in costal area; post cubital space scarcely broader than costal, but about twice as wide as the cubital area; costals and gradates, and a few other cross veins more or less plainly black; inner gradates extended basally; only three or four free intermediates. Navás described it from Yunnan.

CHRYSIDIDIA FUSCATA Navás

PLATE 27, FIGURE 10

Very similar to *regulata*, but the pronotum is slenderer and narrower in front; the inner gradates are not extended basally and not parallel to other rows; there may be six gradates in the middle row; the divisory cell small; the costal area broader than in *regulata*; on the outer side of the basal joint of the antennae is a more or less distinct reddish mark; eight or nine cubitals beyond the divisory cell; stigmal area with many cross veins in the costal space, five or six in the subcostal; palpi partly dark; six or seven free intermediates.

One from Chengtu, December 21, 1,700 feet; one from Beh Luh Din, July 23, 6,000 feet; and one from Mount Omei, July 10-15, 4,000-6,000 feet. The last specimen has a reddish mark across each side of face, the divisory ends at the cross vein.

Genus CHRYSOPA Leach

The species of *Chrysopa* from western China known to me are separable as follows:

1. A dark spot under each antenna----- 2
No dark spot under each antenna----- 6
2. These spots connected up to those on vertex to form an X----- *furcifera*
These spots not so connected----- 3
3. Two spots on vertex and one between antennae----- 4
No spots on vertex----- 5
4. Most costal cross veins dark; stigmal costal area not cross-
veined----- *bicristata*
Only a few costals near base dark; stigmal costal area with cross
veins----- *kreyembergi*
5. A spot below outer side of each antenna, one on each cheek, and
one each side on clypeus, thus three spots close together on
each side of face; palpi partly dark----- *illota*
A spot below each antenna, and one on each side of the clypeus,
none on cheeks; palpi pale; stigma veined----- *cognata*
6. In forewing a dark spot covering the end branches of anal
vein; palpi pale, no marks on head; stigmal costal area
veined----- 7
No such spot on forewing----- 8
7. Some costal cross veins near base are partly black; few costal
cells three times as long as broad; hairs on veins moderately
long----- *chione*
Costal cross veins wholly green, very numerous, and many cells
fully four times as long as broad; hairs on veins very long----- *grahami*
8. Branches of anal vein partly dark; divisory veinlet ends beyond
cross vein; a dark spot on cheek----- 9
Branches of anals pale, divisory rarely ends beyond cross vein----- 10
9. Palpi pale; stigmal costal area not veined; sides of pronotum
without reddish----- *kiansuensis*
Palpi dark; stigmal costal area with many cross veins; sides of
pronotum reddish----- *alethes*

10. No spots on face; veins wholly pale, palpi pale----- carnea
 A dark spot on each cheek, and often on sides of clypens----- 11
 11. Divisory ends at or before cross vein; gradates in each row
 widely separated; palpi partly dark----- sinica
 Divisory ends much beyond cross vein; gradates less separated
 from each other----- fratercula

CHRYSOPE GRAHAMI, new species

PLATE 27, FIGURES 7, 13

Head and body pale, unmarked, antennae and palpi pale; wings with greenish venation; stigma rather dark, long, the costal part broad and with many cross veins, subcostal part with two or three cross veins; inner gradates dark; a black spot over the ends of the first anal vein and its connection to the cubitus; in hindwings all veins pale, but the inner gradates may be a little darker.

Wings broad, apex of hind pair acute, hairs on veins very long. Forewing with the divisory veinlet ending beyond the cross vein, eight or nine cubitals beyond it; inner gradates point toward the stigma, not extended basally, outer gradates parallel to outer margin, about 10 in each row, and in the row rather close to each other; radial sector moderately curved; costal space at widest almost equal to the postcubital area, latter from two and a half to three times as broad as the cubital area; the costals are very numerous, fully 30 before the stigma, and many of the cells are more than four times as long as broad; about 16 radial cross veins. In hindwing the gradates are about eight in each row, not parallel; the triangle between radial sector and median vein near base is larger than usual.

Forewing, 19 to 20 mm. long; 7 to 7.5 mm. wide.

Three specimens from near Washan, Szechwan, July 26, 6,000 feet. Holotype, U. S. N. M. No. 53148. Paratypes in U. S. N. M. and M. C. Z.

CHRYSOPE CHIONE, new species

PLATE 27, FIGURE 12

Similar to *C. grahmi*, not quite so large, but with the same black spot over the anals as in that species, also there are no marks on head or body, and antennae and palpi are pale; the stigma is also like that species, and the divisory veinlet, and eight or nine cubitals beyond as in *grahmi*.

The forewings have the costal area much less broad and the costals fewer, so that no costal cell is over three times as broad as long, and 6 to 10 of the costals toward base of the wing are partly black on outer half; the inner gradates are dark, also sometimes the base of the radial sector, otherwise the veins are pale.

In hindwing all the veins are pale, except sometimes the costals are partly dark. In the forewing the post cubital area is about two to two and a half times as broad as the cubital area.

Forewings, 15 to 17 mm. long; 5.5 to 6.3 mm. wide.

From Beh Luh Din, July 27-31, 6,000 feet (holotype), and Mount Omei, July, 11,000 feet, both Szechwan. Probably similar to *C. dasyphlebia* McLachlan, but that species has no black spots. Holotype, U. S. N. M. No. 53149. Paratype in M. C. Z.

CHRYSOPE FRATERCULA, new species

Head pale, a dark mark under each eye, and one on lateral edge of clypeus; palpi lightly marked with dark lines; antennae pale; thorax, legs, and abdomen pale. Forewings with pale greenish venation, the gradates dark, many other cross veins dark at one end, the costals at the subcosta, the radials at each end, the branches of radial sector at the sector, and a few other cross veins toward base are partly or wholly dark; stigma not very distinct. In hindwings some of the costals and radials dark at one end, and the gradates partly or wholly dark.

Wings of moderate width, acute at tip of hind pair, hairs rather short.

In forewing the divisory ends beyond the cross vein, six cubitals beyond it; postcubital area not twice as broad as the cubital, but about as broad as the costal area; stigmal costal area without cross veins, about four in subcostal part; gradates about seven in inner and eight in outer row, parallel, in each row each veinlet is well separated from the next (but not nearly so much so as in *C. sinica*.) In hindwing five gradates in inner row and seven in outer, rows parallel; the triangle between the radial sector and the median is of moderate size.

Length of forewing, 13 mm.; width, 4.5 mm.

One from Shin Kai Si, Mount Omei, July 1-17. Holotype, U. S. N. M. No. 53150.

Probably related to *C. sinica*, but in that species the gradates are fewer and more separated from one another, the divisory ends before the cross vein, the palpi more dark, the pronotum less long, and often reddish marks on head and thorax.

CHRYSOPE KIANSUENSIS Navás

Specimens from Chengtu, 1,700 feet, May 1, May 25, July 13; Shin Kai Si, Mount Omei 6,000 feet and 11,000 feet; Hong Chuen Pin, Mount Omei, August 27, 5,500 feet. One from Chengtu is the size of type and has five gradates in each row, but most of the others are somewhat larger and have one or two more veinlets in each gradate series. There are seven cubitals beyond the divisory veinlet, the postcubital area is hardly one fourth broader than the cubital area; the stigmal costal area is without cross vein, but with two to four in the subcostal part.

CHRYSOPA ALETHES, new species

PLATE 27, FIGURE 15

Head pale yellowish, a dark mark on cheek, and lateral edge of clypeus dark; antennae pale; palpi largely black. Thorax pale, pronotum with a reddish stripe on each lateral margin; legs pale. Forewings with partly pale venation, but about ten or more costals wholly black, the radials partly dark, gradates and the anal branches dark, and also several cross veins in basal part of wing. In hindwings the costals on basal half of wing are dark, the gradates more or less dark, a few radials are partly darkened.

Wings of moderate width, tips subacute; hairs of moderate length.

In forewings the divisory veinlet ends beyond the cross vein, seven cubitals beyond it; the postcubital space not twice as broad as the cubital, but a little broader than the costal area, no costal cell three times as long as broad; about 12 radials; gradates about seven in each row, rows nearly parallel, the inner row extended basally for one or two cells. In the costal area of the stigma are a few cross veins, and in the subcostal part about four cross veins.

In hindwings are four inner gradates and six in outer row, the rows about parallel; the triangle between radial sector and median vein is rather small.

Pronotum broader than long, obliquely narrowed each side in front.

Length of forewing, 12 mm., width, 4.5 mm.

From Taichow, May 15 (holotype), and Chengtu, May 1. By the numerous black cross veins it resembles *C. kiansuensis*, but the palpi in that species are wholly pale. Holotype, U.S.N.M. No. 53151. Paratype in M.C.Z.

CHRYSOPA ILLOTA Navás

PLATE 29, FIGURE 48

Head pale, face with three subequal dark spots each side, one below outer edge of the antenna, one below eye, and one at end of the clypeus; palpi dark, antennae pale, pronotum with anterior corner somewhat reddish. Forewing with costals wholly, the gradates faintly, anal branches, base of radial sector, first intermediate, and the divisory black; radials dark at upper end.

About 12 inner gradates and 7 or 8 outer, in each row they are rather widely separated, the two rows subparallel, except the basal extension of inner row.

Divisory ends beyond the cross vein, eight cubitals beyond; radial sector but little curved; post cubital area once and a half as broad as the cubital area.

In hindwings the costals mostly dark, and also the upper ends of the radials. It was described from eastern China.

Two specimens from Suifu, 2,000 feet, and Songpan, July 11, 8,000 to 9,500 feet.

CHRYSOPE SINICA Tjeder

PLATE 27, FIGURE 11

Extremely common; Suifu, February, March; Beh Luh Din, April; Kuanshien, April, November; Chengtu, March, April, May; O-Er, near Li Fan, August, and Doug Men Wai, all in Szechwan.

I think this is probably the same as *C. hoffmanni* Petersen.

The postcubital area is about twice as broad as the cubital area; six cubitals beyond the divisory; stigmal costal area without veins, and behind in the subcostal area two to four cross veins.

Some specimens are much marked with reddish like the American *C. interrupta*, and since many specimens were taken early in spring I presume that it hibernates as adult, as does *C. interrupta*.

CHRYSOPE KREYEMBERGI Navás

One from Weichow, 65 miles north of Chengtu, August 1, 5,500 feet. The head marks are very similar to *bicristata*, but the costals are mostly pale, only a few near base are darkened, and the costal stigmal area has cross veins; the divisory cell is larger than in *bicristata*.

CHRYSOPE BICRISTATA Tjeder

PLATE 27, FIGURE 14

This is figured by Tjeder from Kansu as well as Szechwan. There are specimens from Beh Luh Din, July 28, 6,000 feet; near Yen Tong Shien, August 2, 1,300 to 1,600 feet; Ma Si Geo, August 17, 5,000 feet; Wen Chuan Shien, 30 miles northwest of Kuanshien, August 26, 5,000 feet; Doug Men Wai, August 18 (all Szechwan); and Yin Kuan Tsai, Tibet, July 22, 13,000 feet.

The costal stigmal area is not veined; six cubitals beyond divisory. It also occurs in Shantung and has been identified by Petersen as *bipunctata* Burmeister, described from Japan, but Burmeister mentions only the dark spots below antennae, none on vertex or cheeks.

CHRYSOPE COGNATA McLachlan

PLATE 27, FIGURE 16

There are about 20 specimens of this widespread species: Suifu, April 24; Shin Kai Si, Mount Omei, August 17-25, 4,500 feet; La Ka

Pin, Mount Omei, August, 6,000 feet; Mount Omei, September 24; Chengtu, September 1 (all Szechwan); and Kiating, China. *C. ricciana* Navás is a synonym.

There are seven and sometimes eight cubitals beyond the divisory; the stigma has cross veins in the costal area; postcubital area not twice as broad as cubital; inner gradates usually extended basally, the rows parallel and parallel to hind margin. In one specimen the third cubital cell is divided longitudinally as in *Nothochrysa*.

Family OSMYLIDAE

Genus OSMYLUS Latreille

OSMYLUS PUNCTIPENNIS Walker

One from between Fu Yao Lin Pass and Da Siang Pass, Szechwan, 600 feet.

This agrees well with a specimen from northeast India taken by Thorey in 1865 but is a little larger (forewing 28 mm. long), but venation and the small dark dots are the same. It was described from North India; *Dictyosmylus lunatus* Navás, from the Himalayas, is the same.

Genus SPILOSMYLUS Kolbe

SPILOSMYLUS OBERTHURINUS Navás

Three females, one from Chin Chi Shien, west of Yachow, July 10, 5,500 feet; one from Shin Kai Si, Mount Omei, July, 4,400 feet; and one from Beh Luh Din, 30 miles north of Chengtu, July 25, 6,000 feet. Described from Yunnan.

SPILOSMYLUS EPIPHANES Navás

One from Szechwan (no definite locality).

Family MYRMELEONIDAE

Genus DENDROLEON Brauer

DENDROLEON INSOLITA, new species

Head pale, a broad black interantennal band from eye to eye, vertex in front with transverse dark bands each side, not reaching eyes, and above on each side two dark transverse areas widest near middle, and bordered with pale, the posterior one connected to a short longitudinal dark spot, also bordered with pale; pronotum pale, three narrow black stripes, the lateral ones halfway to margin; meso- and metanotum broadly dark through middle and each side with two dark lines; pleura pale, with a black stripe. Abdomen pale above, dark on sides and at ends of joints; venter pale, darker at tips of

joints; legs pale, first femora mostly black above, tibia also with dark stripe above, apical half of tarsus dark; hind femora mostly dark, but a pale stripe each side.

Wings pale, no large marks, nor any distinct stripes as in *D. floridus*; veins mostly dark, subcosta with numerous short pale spots, radius with much fewer but longer pale streaks, other longitudinal veins pale in streaks, many cross veins partly or wholly dark, but some, especially toward tip, are white; in forewings a dark dot at end of anal, one on hind margin two-thirds way out to anal dot, another at rhexma, and one over last radial cross vein before stigma, latter indistinct; many of outer forkings are more or less dark; the fork of medius is jet black. Hindwings without these dark spots, but the veins more or less marked with dark.

Wings a little slenderer than in *D. floridus*, the tips slightly falcate; the costal area not so broad as in *D. floridus*, more like *D. pantherinus*. Three cross veins before radial sector in forewing, eleven branches to radial sector, the cubital fork runs down nearer to margin than usual, the outcurving vein from end of cubital fork is not so long as in *floridus*, only three connections to the cubitus and these not crossed, the first branch of cubitus beyond the cubital fork is much farther from the next than in *floridus*, about nine cubital cross veins before cubital fork and none of them crossed.

In hindwing but one cross vein before radial sector 11 branches to radial sector, the first farther basad than in *floridus*. Pronotum moderately slender; tibial spurs longer than the long basal joint of tarsus; hair on pronotum, legs, and most of that on abdomen black.

Length of forewing, 35 mm.; width, 9.5 mm.

One from Doug Men Wai, 10 miles west of Weichow, July 21, 5,600 to 8,500 feet, Szechwan. Holotype, U. S. N. M. No. 53152.

This looks like a narrow-winged, unmarked *D. floridus*, but besides the head and pronotal marks there are various differences in venation near cubital fork.

DENDROLEON FLORIDUS Navás

From Shin Kai Si, Mount Omei, August, 3,000–5,000 feet, Szechwan. *D. parabolicus* Navás is a synonym. *D. floridus* was described as a *Glenurus*.

Genus EPICANTHACLISIS Okamoto

EPICANTHACLISIS CONTINENTALIS Petersen

From O-Er, 26 miles north of Li Fan, 9,000 feet; and Beh Luh Din, August 24, 6,000 feet, Szechwan.

Genus EUROLEON Navás

EUROLEON ALIENUS Navás

From Doug Men Wei, 10 miles west of Weichow, August 18–22, July 29, 5,600 feet; and O-Er, 26 miles north of Li Fan, 9,000 feet; both Szechwan.

INDOPHANES, new genus

Belongs to the Glenurini; wings much as in *Paraglenurus* (*Glenuroides*). In forewings the second anal vein runs up close to first, then bends down at an angle to unite to the third; radial sector arises much beyond the cubital fork, about 8 to 10 cross veins before the radial sector; costal cross veins simple, a few beyond middle forked. In hindwings the radial sector arises much before cubital fork, one cross vein before it. Pronotum moderately long; antennae not especially long; legs long and slender, tarsus with basal and apical joints about equally long, spurs long, but equal to only two joints, last tarsal joint not recurved, with many spines below, claws but little more than one half of last joint.

Type, *Myrmeleon barbarus* Walker.

Includes also *M. infestus* Walker and *M. audax* Walker, and the new species below.

The genus is separated from the other Oriental Glenurini as indicated in the following table:

- | | |
|--|---------------------|
| 1. Last tarsal joint recurved, densely clothed below with spreading spines; claws nearly as long as the last tarsal joint..... | <i>Paraglenurus</i> |
| Last tarsal joint nearly straight, not so densely spined, claws shorter..... | 2 |
| 2. More than 12 branches to radius beyond union with subcosta; many costal cells four or five times as long as broad; bristles on hind femora but little longer than width of joint..... | 3 |
| Less than 12 branches to radius beyond union with subcosta; few costal cells (except near stigma) more than three times as long as broad..... | 4 |
| 3. Outer fourth of costal area before stigma with two rows of cells; forewings not falcate at tip..... | <i>Delgadus</i> |
| Only a few costals, if any, before stigma divided; forewings plainly falcate at tip..... | <i>Indoleon</i> |
| 4. Spurs equal to four tarsal joints; hind femora and tibiae heavily spined, lower inner and outer rows of spines..... | <i>Eophanes</i> |
| Spurs equal only about two joints; mid and hind femora only weakly spined..... | <i>Indophanes</i> |

Negrokus Navás, 1930, apparently goes in this tribe; it is said to lack spurs.

INDOPHANES SINENSIS, new species

Head with a black interantennal mark, vertex with dark patch each side; antennae not reaching end of thorax, brown, tips of joints narrowly pale, and a broad pale area over several joints at the beginning of the clavate tip. Pronotum with four black stripes, middle pair well separated and complete, laterals ending at the furrow; rest of thorax above mostly black, some pale on anterior lobe, a short, pale stripe each side on mesonotum, and the hind margins of scutelli pale; pleura mostly dark. Abdomen dark; tip of first segment pale, second and third segments with a median pale spot before the middle, and the tips narrowly pale; other segments narrowly pale at tip; hair short and black, except in pale areas.

Legs slender, pale, femora and tibiae rather minutely dotted, and with black bands at tips, tibiae also with a dark mark near base, and hind tibiae with two dark lines, one on anterior side, other on outer side; tarsal joints dark at tips.

Wings hyaline; veins mostly dark, and the longitudinal veins interrupted with pale; stigma pale, rhexma with an oblique dark streak, and before it are some wholly white cross veins; an oblique dark line up from end of cubital fork; in hind wings stigma pale, and a dark spot at rhexma; in both wings a few outer cross veins are margined with dark, and beyond rhexma the outer marginal veins dark, but no distinct cloud.

Pronotum a trifle longer than broad, not so slender as in *barbara* but fully as long as in *audax*. Forewings slightly more acute than *barbara*; hindwings no longer than forewings, and acute at tip; in forewings about eight cross veins before radial sector, none crossed, nine or ten branches of radial sector; before the cubital fork no cross veins connected; one cross vein from second anal back to first at the union of second and third, third anal forked, or so united the fork may appear from second anal.

Forewing length, 32 mm.; width, 9 mm.

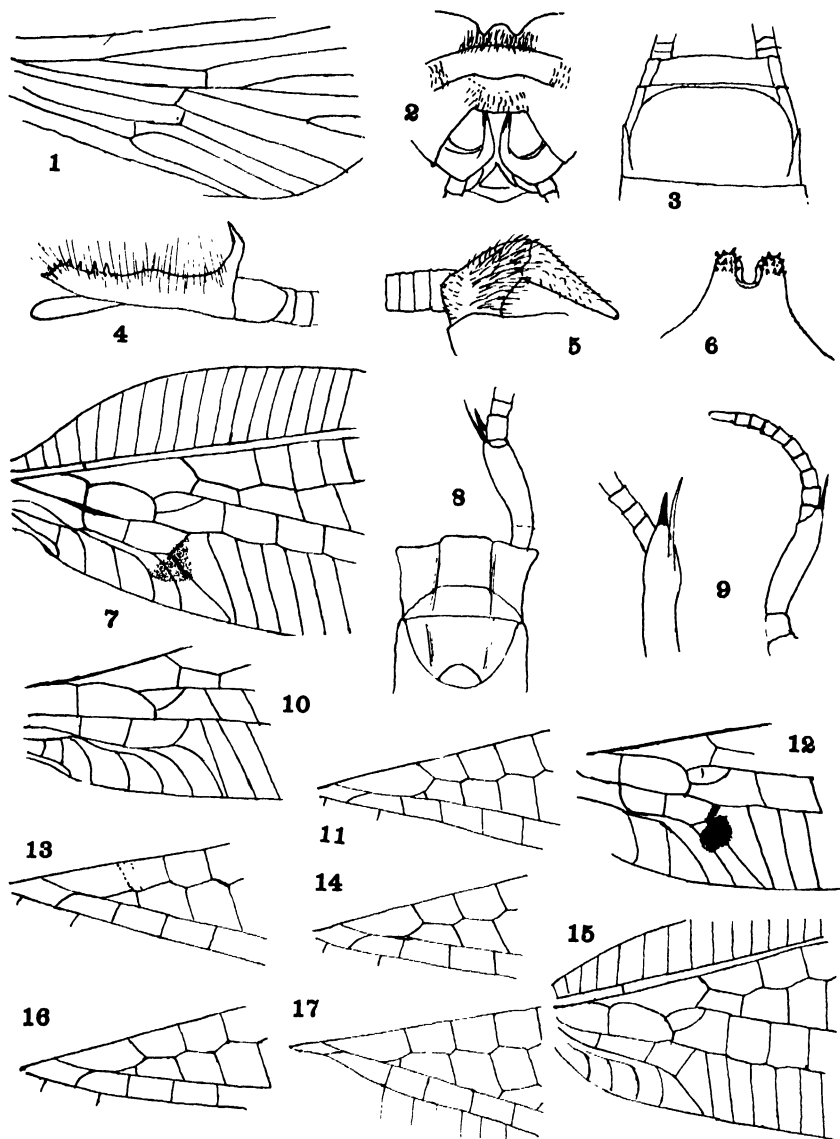
From Szechwan (no definite locality), China (Graham). Holotype, U.S.N.M. No. 53153. Paratypes in U.S.N.M. and M.C.Z.

Family RHYACOPHILIDAE

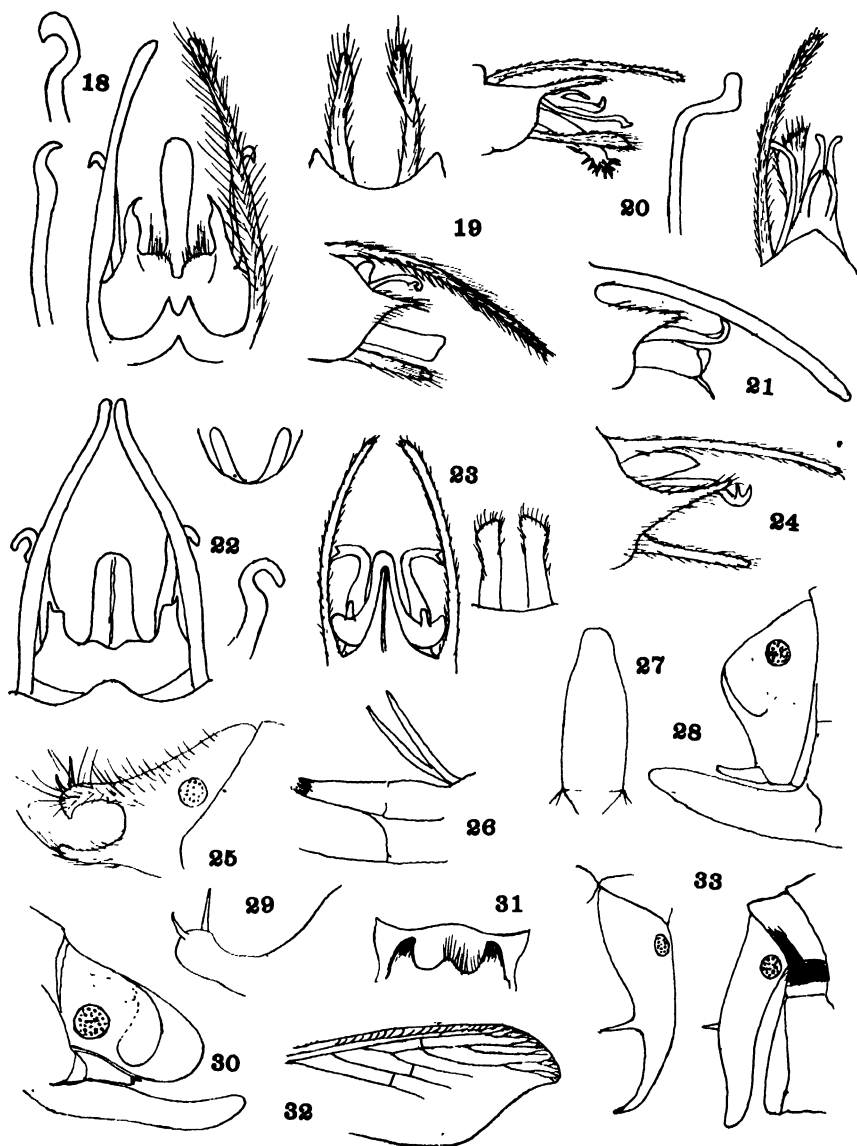
Genus RHYACOPHILA Pictet

RHYACOPHILA SINENSIS Martynov

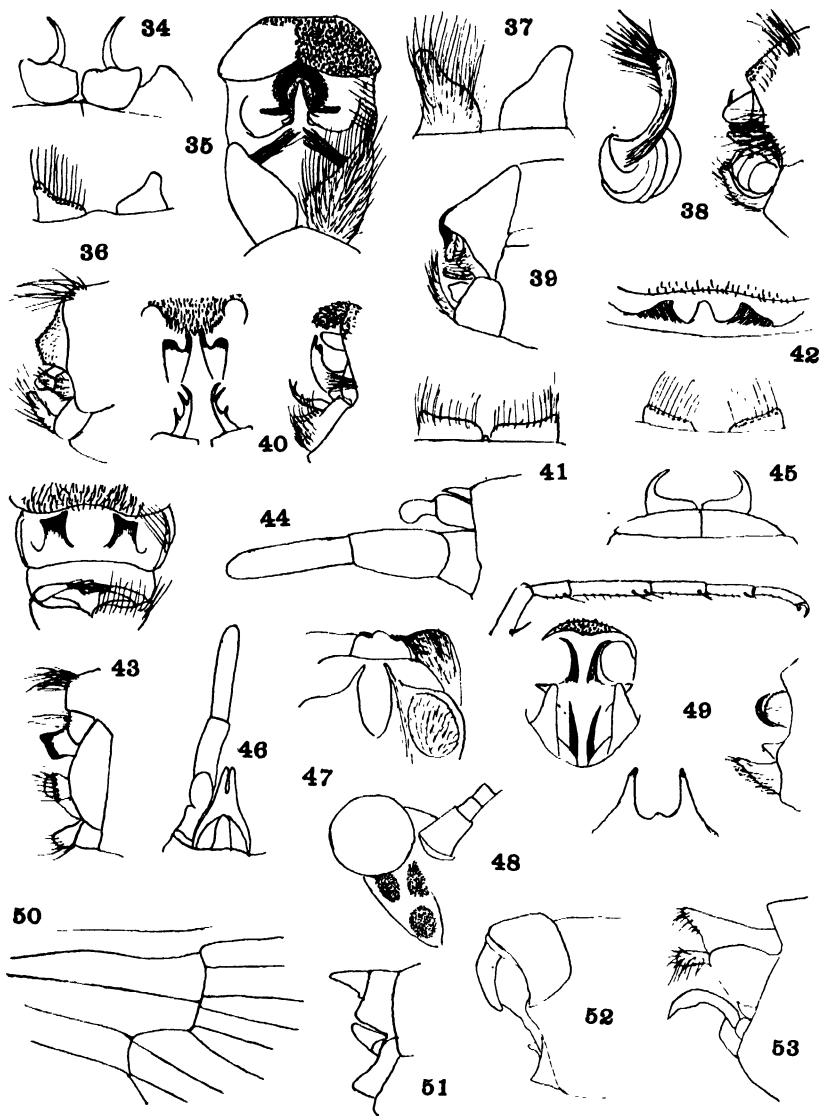
From Wei Chow, August 10, 7,000–12,500 feet, and O-Er, 6 miles north of Li Fan, August 16, 10,800 feet, both Szechwan. This species is very close to *R. hobsoni* from Tibet. In *sinensis* the second joint of the lower appendages is shorter and the lower branch no longer.



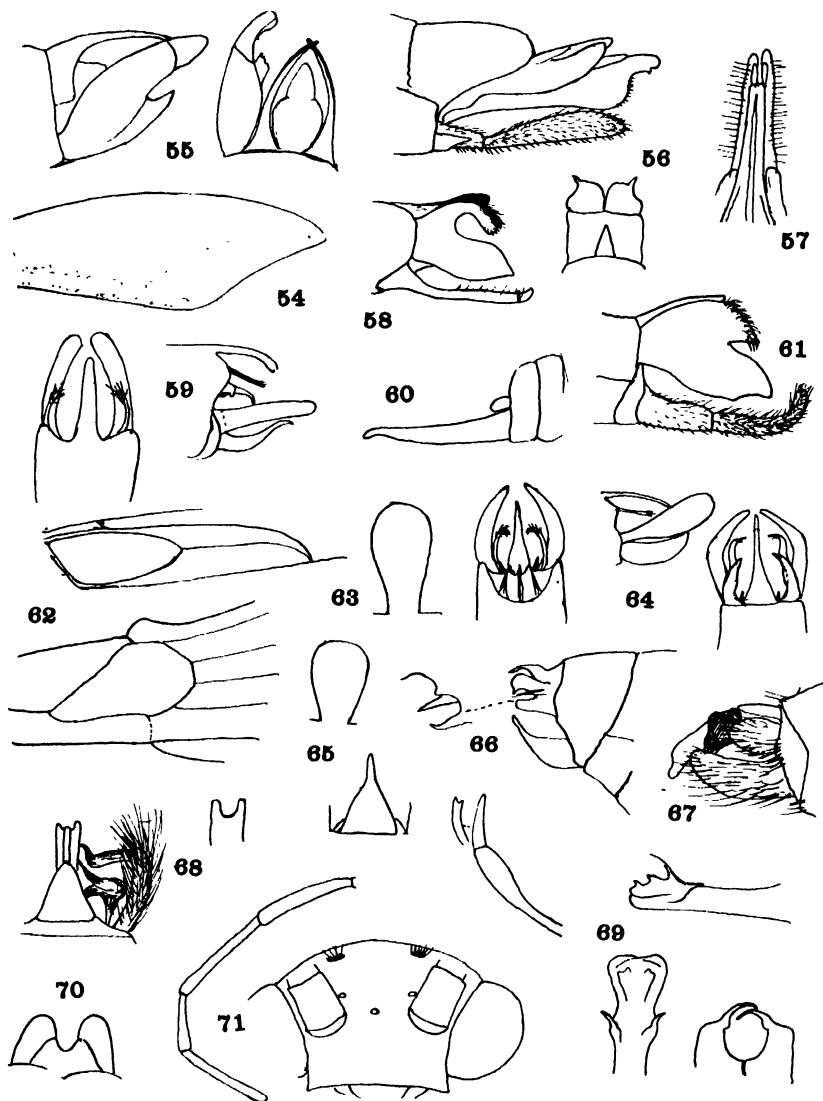
1. *Psilotreta chinensis*, new species: Forewing. (See also figs. 67, 68, 70.)
- 2, 5. *Togoperla grahami*, new species: 2, Genitalia; 5, genital process from side.
- 3, 8, 9. *Nogiperla chiangi*, new species: 3, Ventral plate; 8, male venter; 9, cercus from side and above.
- 4, 6. *Marthamea armata*, new species: 4, Genital process from side; 6, tip of fifth dorsal segment.
- 7, 13. *Chrysopa grahami*, new species: 7, Forewing; 13, part of hindwing.
10. *Chrysopidia fuscata* Navás: Forewing.
11. *Chrysopa sinica* Tjeder: Part of hindwing.
12. *Chrysopa chione*, new species: Part of forewing.
14. *Chrysopa bicristata* Tjeder: Part of hindwing.
15. *Chrysopa alethes*, new species: Part of forewing.
16. *Chrysopa cognata* McLachlan: Part of hindwing.
17. *Chrysopidia regulata* Navás: Part of hindwing.



- 18, 19. *Stenopsyche moselyi*, new species: 18, Genitalia from above, titillator from side and below; 19, genitalia from side, lower appendages from below.
20. *Stenopsyche martynovi*, new species: Genitalia, side and above; titillator, below.
- 21, 22. *Stenopsyche pjasetzkyi* Martynov: 21, Genitalia from side; 22, genitalia from above, titillator from below, lower appendages from below.
- 23, 24. *Stenopsyche navasi* Ulmer: 23, Genitalia from above, lower appendages from below; 24, genitalia from side.
- 25, 29. *Hemerobius bispinus*, new species: 25, Male appendage from side; 29, tip of upper appendage from above.
- 26, 28. *Neuronema laminata* Tjeder: 26, Inner appendage from side; 28, genitalia, side.
- 27, 30. *Neuronema similis*, new species: 27, Last ventral segment; 30, genitalia from side.
31. *Pseudostenophylax minimus*, new species: Median teeth. (See also fig. 36.)
32. *Allemerobius flaveolus*, new genus and species: Part of forewing.
33. *Hemerobius chiangi*, new species: Genitalia from side and above.



- 34, 41, 43. *Pseudostenophylax brevis*, new species: 34, Tip of female from above; 41, lower appendages; 43, median teeth and genitalia from side.
- 35, 39. *Pseudostenophylax amplus* (McLachlan): 35, Male, behind; 39, genitalia, side.
36. *Pseudostenophylax minimus*, new species: Lower appendages and genitalia from side. (See also fig. 31.)
- 37, 38, 51. *Pseudostenophylax (Trichophylax) monticola*, new species: 37, Lower appendages; 38, inner appendages and genitalia from side; 51, female from side.
40. *Platyphylax rubescens* Martynov: Male from behind and side.
- 42, 45. *Pseudostenophylax mimicus*, new species: 42, From behind; 45, tip of male, above.
- 44, 46. *Philopotamus sinensis*, new species: 44, Genitalia from side; 46, genitalia, above.
47. *Pseudostenophylax amplus* (McLachlan): Female from above.
48. *Chrysopa illota* Navás: Side of head.
- 49, 50. *Psilopterna sinensis*, new species: 49, Male from behind, from side, front tarsus, and tip of female from above; 50, part of forewing.
52. *Sialis sinensis*, new species: Tip of abdomen from side.
53. *Ilalesinus fenestratus*, new species: Female from side.



- 54, 55. *Himalopsyche navasi*, new genus and species: 54, Forewing; 55, genitalia from side and above.
- 56, 60. *Himalopsyche (Himalophanes) anomala*, new subgenus and species: 56, Genitalia from side, tip of female from above; 60, ovipositor.
- 57, 58. *Himalopsyche martynovi*, new species: 57, Superior plate; 58, genitalia from side.
59. *Himalopsyche hageni*, new species: Genitalia from above and side.
61. *Himalopsyche alticola*, new species: Genitalia from side.
- 62, 65, 66. *Glossosoma aequalis*, new species: 62, Anal area of forewing and discal cell; 65, ventral process and superior plate; 66, genitalia from side.
63. *Glossosoma anale* Martynov: Ventral process.
64. *Himalopsyche lachlani*, new species: Genitalia from above, side, and below.
- 67, 68, 70. *Psilotreta chinensis*, new species: 67, Genitalia from side; 68, genitalia from above and tip of penis; 70, lower appendages. (See also fig. 1.)
69. *Hydropsyche grahami*, new species: Clasper, penis from side and above, and superior plate from above.
71. *Evanophanes insignis*, new genus and species: Head from above and maxillary palpus.

RHYACOPHILA GRAHAMI, new species

Body brown to black, tip of abdomen yellowish; basal joint of antenna dark, beyond pale; legs mostly pale, but tibiae broadly dark at tips of front and mid pairs, mid and hind tarsi dark.

Forewings dark brown, with scattered small pale spots, mostly along each side of the veins, some in the costal area, from cubitus to second anal darker; the anal area mostly pale, with some brown spots, especially toward its tip; there are two large pale areas reaching forward from the anal area almost to the cubitus; the first one (before middle) is narrow and its apex sometimes a separated spot, the second one (near tip) is much broader and reaches the cubitus in two spots a little before the base of fork five. Hindwings gray, darker in stigmal area. Legs slender, spurs quite long, spurs and weak spines are yellowish.

In forewing fork one is a little before two, forking of the medius just about opposite that of radial sector, forks three and four both with long pedicel. In hindwing fork one is beyond fork two. The female has a short, tapering ovipositor.

Length of forewing, 13 mm.; width, 4.2 mm.

From Yellow Dragon Temple, Songpan, 12,000 to 14,000 feet.

The large pale spots will readily separate it. Holotype, U.S.N.M. No. 43154. Paratype in M.C.Z.

HIMALOPSYCHE, new genus

In nearly all respects like *Rhyacophila*; it is at once separated therefrom by the presence of a broad wart on the metacutellum. This wart is often more or less plainly divided, and bears long hairs. There is no ventral process to the abdomen, and the wings, both fore and hind, show a stigmal vein, a branch of the radius or of the subcosta and usually connected to both. All are large species, with more or less pointed wings.

Genotype, *Rhyacophila tibetana* Martynov.

It includes also *R. carletoni* Banks, *R. auricularis* Martynov, and doubtless *maculipennis*, *lanceolata*, *gigantea*, *japonica*, and all the very large Asian species and the several new species below.

HIMALOPSYCHE HAGANI, new species**PLATE 30, FIGURE 59**

Head dark, some pale hair in front, that on vertex black; palpi dark brown; antennae dark on the basal joint, beyond pale, faintly annulate. Thorax dark brown on the sides above, more reddish through the middle, bristles from the strips pale; abdomen dark above, tips of segments pale, pale beneath. Legs pale, front femora

darker, front and mid tibiae with dark marks near the middle and before the tip. Forewing mostly brown, with many small pale spots, mostly on or near costal area before stigma, along veins, and an oblique area across the apical cells, a white spot on margin in each apical cell; behind toward base are two larger pale areas, sometimes connected, both somewhat triangular, mostly behind the anal vein, but the outer one reaching forward to the cubitus; there is much black hair along cubitus and anal veins. Hindwings faintly gray, marked with brown toward tip, especially in front.

Venation much as in other species, fork one plainly before fork two in forewing, not in hindwing; outer margin of wing hardly convex. Male genitalia similar to *R. maculipennis* Ulmer; but the intermediate appendages are much shorter, the superior median process more heavy, the inferior appendages broader, not widened before tip, and the penis shows two teeth below.

Forewings, 20 mm. long; 6 mm. wide (Ulmer gives no size to *R. maculipennis*), other specimens 15 to 22 mm.

From 9 miles southwest of Tatsienlu, June 23-27, 8,500 to 13,000 feet (Holotypes); Wenchuan, November, December; Wa Si Geo, August 18, 6,000 feet; Hai Tsi Ping, near Tatsienlu, August 5, 13,000 feet; Jedo, near Tatsienlu, August 16; Chiang Ku, July 12-15, in Szechwan.

Holotype, U.S.N.M. No. 53155. Paratypes in U.S.N.M. and M.C.Z.

The male genitalia are very similar to those of *R. maculipennis* Ulmer from Kuku-nor, but the lower appendages are evidently heavier in *H. hageni*, the superior median piece broader at base; and in the description of forewings there is no mention of the large pale spots in anal area, and the ground color is evidently pale, while in *hageni* the membrane is largely dark except for pale spots.

HIMALOPSYCHE LACHLANI, new species

PLATE 30, FIGURE 64

Head dark, hair mostly black; palpi dark, basal joint of antennae dark, beyond pale brown, tips of joints narrowly pale; thorax above dull reddish brown, sides hardly darker, bristles from strips and those above wing base black. Abdomen dull reddish brown, tip and venter paler. Legs pale, front and mid tibiae mostly dark, but a narrow pale band a little before the tip.

Forewings brown, densely and rather evenly sprinkled with pale spots, the brown with short golden hair, the pale spots with white hair; much black hair near cubitus and anal veins. The pale spots most numerous along veins, many in costal area, one on margin in each apical cell, no larger pale areas. Hindwings gray, slightly marked with brown in apical area in front, and along outer margin are a few faint pale spots.

Venation much as in others; fork one plainly before fork two in forewings, not in the hindwings; stigmal vein a branch from the radius, but in hindwings with an oblique connection from base to the subcosta.

Male genitalia rather short; above is a slender, pointed, median piece, widened and tricarinate at base, intermediate appendages slender, more than one halfway to tip of median piece, and with recurved bristles near tip; lateral appendages strongly spatulate, lower pieces broad and with an upturned tip; both from above and below is seen a little black spine each side near the base.

Forewing, 21 mm. long; 6.5 mm. wide.

From Yu Long Si, 15,600 feet, August 14, Tibet (holotype); Chung Ku, July 12–15, 11,000 feet; and Hai Tsi Ping, near Tatsienlu, August 5, 13,000 feet, Szechwan. Holotype, U.S.N.M. No. 53156. Paratype in U.S.N.M. and M.C.Z.

HIMALOPSYCHE AURICULARIS (Martynov)

Two females from U Long Kong, near Tatsienlu, July 25, 10,000 to 15,000 feet. The type (a male) was from Tatsienlu, with expanse of 52 mm. One of the females is about 53 mm., the other 50 mm. The female differs from *H. martynovi* in that the ventral piece is a long, slender horn.

HIMALOPSYCHE MARTYNOVI, new species

PLATE 30, FIGURES 57, 58

Head and palpi pale rufous, hair on front yellowish, on vertex black; antennae pale brownish yellow, basal joint darker, tips of joints beyond also dark; thorax above dull rufous, darker on sides of mesonotum, hair pale, except that above wing base which is black; abdomen dull brownish, tip and venter paler; legs pale, front and mid tibiae with broad black bands above at middle and at tip, these tarsi dark at tips of the joints.

Wings pale, nearly hyaline, densely irrorate with pale brown, spots most noticeable in costal area, and along the veins, between veins faint and minute irrorations; stigma dark; along cubitus and anal veins much black hair, and an oblique line of black hair from hind base of wing obliquely up to base of cubitus; a hyaline spot on thyridium.

Hindwings pale gray, stigma darker. In forewings forks one and two are about equal, in hindwing fork one much beyond fork two.

Male genitalia has a slender reddish median plate ending in two long lobes, and with a median groove from near base to near tip, each side the lateral appendages have erect hair; seen from side the lateral appendages are very broad, deeply divided, the upper part much the

smaller and shorter and ends in a down-curved swollen lobe, the lower part is somewhat ligulate and tapers to a sharp tip; lower appendages very long and slender, the apical part short and slightly upturned.

Forewing, 21.5 mm. long; 7 mm. wide.

From near Tan Gu, 14,000 feet, August 3-6, Tibet. Holotype, U.S.N.M. No. 53157.

A female from O-Er, 26 miles north of Li Fan, August 16, 10,800 feet, Szechwan, may be the same species; it is scarcely differently marked, but fork three in fore and hind wing reaches to the cross vein, while in the type, as in all other species seen, fork three has a pedicel at least a fifth of the length of the fork.

HIMALOPSYCHE ALTICOLA, new species

PLATE 30, FIGURE 61

This is closely related to *H. martynovi* in size, color, markings, shape, and venation of wings but differs in the male genitalia. Seen from above there is a long median projection ending in two lobes much as in *martynovi*; seen from side the broad plate is divided by a narrow incision on its outer edge, the upper part is broad, with an oblique outer edge, somewhat incurved, and very hairy, the lower part is also broad, its lower edge on the apical half is concave. The lower appendages are heavier than in *H. martynovi*, and the division is near the middle; they are also hairier than in *martynovi*.

From Chagra Pass, July 18, 13,000 to 14,000 feet (holotype); Chung Ku, July 12-15, 11,000 feet; Jedo, near Tatsienlu, August 16, 12,000 feet; Shin Kai Si, Mount Omei, August 6-7, 4,500 feet; Wenchuan, November, December; and no definite locality, July 9-12, 6,000 to 13,500 feet, all Szechwan.

Holotype, U.S.N.M. No. 53158. Paratypes in U.S.N.M. and M.C.Z.

HIMALOPSYCHE NAVASI, new species

PLATE 30, FIGURES 54, 55

Head, palpi, and antennae pale yellowish, with white hair on head, vertex with a brown stripe each side near middle; antennae unmarked; mesonotum pale in middle, brown, on sides, hairs from the strips pale, and those above wing base also pale; metanotum obscure dull brownish; abdomen dark brown above, tip and venter paler; legs very pale, front and mid tibia not marked with dark.

Forewings pale, marked with pale brown and some dark brown, a double pale-brown streak near the outer margin, a more or less definite curved dark streak from tip of wing, close by the hyaline spot of thyridium, and thence to the anal veins; from the anal veins back

to base is a broad brown streak, and most of anal area brown; in these dark areas there are streaks or spots of black hair, three such along hind margin of radius, the first at origin of radial sector, a long one over base of posterior side of fork two; on the pale areas of membrane there is very short golden hair.

Hind wings faintly yellowish, the stigma more plainly so, all clothed with fine yellow hairs, and the fringe also yellowish.

In forewings fork one is plainly a little before fork two, in hind wings scarcely before, fork three in forewing has a long pedicel, nearly one-half as long as the fork.

Male genitalia on the plan of *H. japonica* Morton, the lower appendages very large, and with a curved pointed process below, which, seen from above, has its tip toothed. From above the superior plate is broad at base, tapering to the tip, but with rounded sides, plainly indented near middle, and each side is a long slightly curved prong, not curved and sinuate as in Morton's figure 5 of *H. japonica*.

Forewings 17 mm. long; 5 mm. wide.

Male from Yim Na San, Kwantung, June 14 (Gressitt) (holotype); a female, forewing 22 mm. long, from Chengtu, Szechwan (Graham). Holotype in M.C.Z. Allotype, U.S.N.M. No. 53159.

This is the species that Ulmer treats in his "Fauna Sinica" as *Rhyacophila japonica*; the inferior appendages are very similar, but the superior parts are very different from Morton's figure and description of the type.

HIMALOPHANES, new subgenus

This I treat as a subgenus of *Himalopsyche*, with which it agrees in general structure, including the hairs on metascutellum; the female, however, has a true ovipositor, so different from the others, and so much like certain Locustidae, that I think it should be separated at least subgenerically. What I consider the male has the genitalia rather different from the style of the others, the upper parts being extended caudally.

HIMALOPSYCHE (HIMALOPHANES) ANOMALA, new species

PLATE 30, FIGURES 56, 60

Head pale dull rufous, with white hair, but black on posterior warts; palpi and antennae pale, latter on upper surface somewhat embrowned. Thorax dull rufous, darker on sides of mesonotum, bristles from the strips pale, those over wing base black; abdomen dull black above, tip and venter paler. Legs pale, front and middle tibiae above with dark mark at base, beyond middle, and at tip, tips of these tarsal joints dark. Forewings densely irrorate with brown spots, mostly near front and hind margins and along the veins, between veins spots small or faint, several of the larger brown marks

tend to form oblique bands over the cubital and anal veins, two or three pale spots on margin of each apical cell. Hair on membrane partly black, partly yellowish. Hind wings grayish, stigma more yellowish, and some faint brown marks along outer margin.

Forewings proportionally broader than in other species, venation much as in others, fork one in forewings hardly or a little before the second, in hindwings fork one beyond or almost equal to fork two, fork three of forewings with the usual short pedicel.

The ovipositor is very long, narrowed, and a little down-curved near tip; its length is about twice the height of last abdominal segment; its two internal blades have a thickened dorsal edge, and end in a spine. It is not the gradually tapering ovipositor found in various *Rhyacophila* but looks much like those of certain Orthoptera, for example *Udeopsylla*.

Length of forewing, 20 mm.; width, 8 mm.

From 9 miles southwest of Tatsienlu, Szechwan, July 23-27, 8,500 to 13,000 ft. (holotype); and near Washam, July, 4,000 to 6,000 feet. Holotype, U. S. N. M. No. 53160. Paratypes in U. S. N. M. and M. C. Z.

I have described these females on account of the remarkably orthopteroid ovipositor; they cannot be the females of any male of *Himalopsyche* that I have seen, and the females are described for several that I have not seen.

A male from Chengtu, 1933, is probably the male of this species; the upper parts of the genitalia are greatly elongated, the tip of the middle appendage ending (seen from above) in two lobes, each with a small tooth, the lower appendages are long, widest toward tip, the apical section more than twice as long as the basal part. The general appearance, size, coloration, and venation agree with the females.

Genus GLOSSOSOMA Curtis

GLOSSOSOMA AEQUALIS, new species

PLATE 30, FIGURES 62, 65, 66

This is very similar to *G. anale* except in the male characters of wing and genitalia; in the anal area of forewings the swollen area is much shorter, scarcely halfway to end of the second anal vein, whereas in *G. anale* it is more than two-thirds the way to end. In *G. anale* the area is densely clothed with short, yellowish, scalelike hairs all over; in *G. aequalis* there are some yellowish hairs in basal half, not so scalelike, and beyond are few yellowish hairs but many short black bristles.

Venation is much as in *G. anale*, but the discal cell has a short straight top, and there is a distinct connection back to the curve of the radius; cell two is broader at base than in *G. anale*, and the connection to

median vein is much before the base of the third cell. The male genitalia has the median ventral piece with a slender tip, from side the apical pieces are more pointed; the process of the seventh ventral segment is very broad, and shorter than in *G. anale* (fig. 63).

Length of forewing, 8 mm.

Several specimens from Beh Luh Din, 30 miles north of Chengtu, August 7–28, 6,000 feet (holotype); Wenchuan, November–December; and Kuanshien, November 20. Holotype, U.S.N.M. No. 53161. Paratype in M.C.Z.

GLOSSOSOMA CAUDATUM Martynov

One male from Beh Luh Din, August 7, 6,000 feet, and one from Wenchuan, November. The anal area is extremely similar to that of *G. malayanum* Banks, but in the latter the median ventral piece is broad and has a long, slender tip. *G. valvatum* Ulmer is also similar in anal area, but the superior pieces (seen from side) are quite different; it occurs in eastern China.

GLOSSOSOMA ANALE Martynov

PLATE 30, FIGURE 63

Two from Shin Kai Si, Mount Omei, July.

Family HYDROPSYCHIDAE

Genus STENOPSYCHE McLachlan

The species of *Stenopsyche* that are recorded below can be distinguished by the following table:

- | | |
|--|-----------|
| 1. In hindwings the little cell at end of the united subcosta and radius is incomplete; in male the titillators are forked at tip or have lateral projections; larger species..... | 2 |
| In hindwings the little cell is complete; in male the titillators are neither forked nor have lateral processes..... | 3 |
| 2. Male titillators have some lateral processes before tip; forewings rather long, rarely with large pale areas behind..... | grahami |
| Male titillators have the tip forked; wings broader, and usually with one or more large pale areas behind..... | navasi |
| 3. The processes of the superior plate are rather close together at base, and curve downward, nearly parallel..... | martynovi |
| These processes are wide apart at base and do not curve downward, nearly parallel..... | 4 |
| 4. These processes are rather long and curve toward each other horizontally..... | stotzneri |
| These processes do not curve toward each other, their tips far apart..... | 5 |

5. The slightly curved processes arise one each side near the base of the superior plate, which is very long, broad, and narrowed toward tip----- laminata
The nearly straight processes arise from outer corner of the broadly truncate superior plate----- 6
6. The processes are very short, more than twice the length apart, with very short tip, penis with two long spines below near tip-- pjasetzkyi
The processes are fairly long with a long slightly curved tip----- moselyi

STENOPSYCHE NAVASI Ulmer

PLATE 28, FIGURES 23, 24

Many specimens, evidently the most common species: Beh Luh Din; Tatsienlu; Suifu; Wa-Li-Geo; near Washan; Mount Omei; near Kuanshien; Chin Chi Shien; near Moupin, July 22-24; Chung Ku, July 12-25, 11,000 feet (all Szechwan); and near Tang-Gu, Tibet.

STENOPSYCHE GRAHAMI Martynov

From Shin Kai Si, Mount Omei; Beh Luh Din; Li Ki Pin, Mount Omei; near Weichow; Kuanshien; Wen Chuan Shien; near Moupin, July 22-24.

The females resemble those of *S. navasi* but generally have longer wings.

STENOPSYCHE STOTZNERI Dohler

Quite common; from Beh Luh Din; Chengtu; Jedo Pass; Kuanshien; Yin Shien Wan; Wen Chuan Shien; Wa-Li-Geo; Shin Kai Si, Mount Omei; and near Moupin, July 22-24. Mostly in the northern part of Szechwan, described from Kuanshien.

STENOPSYCHE LAMINATA Ulmer

From Chengtu, Mount Omei; Shin Kai Si, Mount Omei, August 6; Kuanshien; and near Moupin, July 22-24.

Forewings paler and less marked than the other species.

STENOPSYCHE MARTYNOVI, new species

PLATE 28, FIGURE 20

About the size and general appearance of *S. stotzneri*; smaller and not so deeply marked as *S. navasi* or *S. grahmi*. Face with yellowish-gray hair below and a small tuft of black each side by the eye; above, between antennae, and on vertex with white hair. Palpi and antennae dull yellowish, latter annulate with brown at tips of the joints; thorax dull yellowish, prothorax, mesothorax in front and meso and metathorax each side behind with rather long white hair. Abdomen dull yellowish brown, appendages paler. Legs pale, broad marks of black near base and just before tip of mid and fore tibiae, and one on these metatarsi, hindtibia of male nearly white. Fore-

wings pale brown, spotted and dotted with hyaline or whitish, hair mostly black and most noticeable near cubitus, much of anal area often pale and toward end of first anal, but the pale spots are mostly irregular and often clustered. Hindwings whitish, gray toward tip.

Forewing about as slender and pointed as *S. stotzneri*, venation as in that species, in the hindwing the end of subcosta runs into the upper branch from discal cell (not in *navasi* or in *grahami*). The male appendages are on the plan of *St. stotzneri*; but the upper appendages are longer, and the lateral appendages much longer, reaching beyond the middle of the upper appendages; the lower appendages are also much longer than in *S. stotzneri*, and widened a little before tip. The titillators are longer, the tip enlarged much like a foot and bent outward (in *stotzneri* simply with a recurved tip); on the superior plate the two curved spinelike processes are wide apart in *stotzneri* and curve toward each other, but in *martynovi* they are close together at base and nearly parallel.

Forewing 21 to 23 mm. long.

From Yin Kuan Tsai, China-Tibet border, 13,000 to 15,000 feet, July 25 (about 15 males) (holotype); also from Yachow, August 28, and Yin Shiu Wan, July 22, both in Szechwan. Various females from these localities evidently belong to this species. Holotype, U.S.N.M. No. 53162. Paratypes in U.S.N.M. and M.C.Z.

STENOPSYCHE MOSELYI, new species

PLATE 28, FIGURES 18, 19

A small species, with numerous brown bars across the cells of the forewing, much as in *S. laminata*.

Face dark; hair on vertex, pronotum, and thorax mostly snow-white, each side on pronotum and at base of forewings there is some black hair. Palpi brown; antennae pale, with an oblique dark ring at tip of each joint; legs pale, with the usual dark bands on front and mid pairs. Forewings with numerous crossbars of brown on a pale ground; in apical part mostly connected; behind are two large elongate dark spots, one just beyond the end of the anal cell, the other where the anal and cubitus approach each other (these marks not in *S. laminata*). Venation as in *S. laminata*, and in hindwing the little cell is complete where the subcosta and radius unite, just as in other small species.

Male genitalia quite different from *laminata*, and other forms; the superior appendages are very long, somewhat widened before middle; the superior plate is large, and notched in middle of apical margin, and from each side arises a process extending backward, with a curved, pointed tip and widened just before this curved part. The lower appendages are slender, not broadened at tip, and a little

curved; the penis is only a little broadened and with only small spines below tip; the titillators are fairly stout, with a sinuous curve before the swollen, pointed tip.

Length of forewing, 21 to 23 mm.; width, 5 to 7 mm.

From Suifu, Szechwan, 1,000 feet, November 5, several specimens. Holotype, U.S.N.M. No. 53163. Paratypes in U.S.N.M. and M.C.Z.

STENOPSYCHE PJASETZKYI Martynov

PLATE 28, FIGURES 21, 22

One male from near Suifu, June 15, 1,000 to 1,200 feet.

A small species, forewings of this specimen 17 mm. long; forewings generally resemble those of *S. laminata* and *S. moselyi*. The genitalia are on the plan of *moselyi*, but the lateral processes of the superior plate are very short and stubby; the titillators are very heavy toward base, and the tip is more strongly curved than in *moselyi*; the penis is fairly large, and near lower tip is a pair of rather long spines (not noticed in *moselyi*; the inferior appendages are not so long as in *moselyi*.

In the hindwings the little cell at end of subcosta and radius is complete, as in other small species. Front and mid legs heavily banded with black on tibiae and tarsi. The eyes of male are large and crowd the antennae, proportionally larger than in *moselyi*; the antennae have the dark mark at tip of each joint so extended as to give the appearance of a spiral marking. It was described from Hanjang, Hupei Province, east of Szechwan.

A female from Kuanshien is of the same size and appearance and may belong to this species.

Three other species are recorded from Szechwan or from nearby districts. These species are based on females; *S. maxima* Martynov from Szechwan is said to have an expanse of 65 mm.; the only one I have seen that is as large is *S. grahami*, and quite possibly it is that species.

S. cinerea Navás has forewings 21 mm. and *S. tibetana* Navás 25 mm. The size would fit any of the four small species; Navás gives a figure of anal area of forewing with a mark I have not seen on any of my specimens; *S. cinerea* may be *laminata*, as the other species are too dark to be called "*cinerea*."

Genus POLYMORPHANISUS Walker

POLYMORPHANISUS UNIPUNCTUS, new species

Pale greenish or yellowish, antennae black beyond base, legs pale, unmarked, fringe of midlegs blackish, abdomen dull black, mesoscutellum with a large black spot in front part. Forewings rather broad, the discal cell is short, not one-half as long as the pedicel, fork

four goes back on discal cell about halfway to the cross vein, latter beyond the middle of the cell, cross vein between median fork and cubitus oblique, and fully three times its length before the median cell; in hindwings venation similar to *P. nigricornis*.

Length of forewing, 25 mm.

Two from Suifu, Szechwan, August. Holotype, U. S. N. M. No. 53164. Paratype in M. C. Z.

Genus AMPHIPSYCHE McLachlan

AMPHIPSYCHE PROLUTA McLachlan

One from Suifu, Szechwan, August; known from Siberia.

Genus CHEUMATOPSYCHE Wallengren

CHEUMATOPSYCHE species

Two females, one from Shin Kai Si, Mount Omei, 4,400 feet, and the other from Beh Luh Din, July 28, 6,000 feet, have evenly brownish wings with yellowish hair, rather large, and may be new.

CHEUMATOPSYCHE CHINENSIS form MACULIPENNIS Martynov

One female from Suifu, August 1928, is probably this species; at least the markings of the forewings agree with the description. It was described from Tchang, Cham.

Genus HYDROPSYCHE Pictet

HYDROPSYCHE HEDENI Forsslund

A large number of specimens from Suifu, August 1928, Szechwan, and without definite locality but probably Suifu. It was described from northern Szechwan and southern Kansu.

HYDROPSYCHE PENCILLATA Martynov

Several from Kuanshien, April 5 to May 8, 3,000 feet; Beh Luh Din, August 22-27, 6,000 feet; Mount Omei, July; Chengtu and Suifu, August; near Tatsienlu, June.

HYDROPSYCHE COLUMNATA Martynov

A few from Beh Luh Din August 7, 6,000 feet; also from Szechwan (no definite locality) probably Suifu; Chengtu, July 3-5, 1,700 feet; and Tseo Jia Geo, south of Suifu, September, 1,400 to 2,000 feet.

HYDROPSYCHE RHOMBOANA Martynov

Two males from 30 miles north of Tatsienlu, July 5-9, 12,000 feet and Kuanshien; described from eastern Tibet.

HYDROPSYCHE GRAHAMI, new species

PLATE 30, FIGURE 69

Head with some dark hair on face, on vertex pale yellowish, on back of vertex some black hair each side; pronotum with mostly pale hair; antennae pale, a dark ring over joinings. Forewing with short black hair, many small spots of pale yellowish hair, in apical cells two rows of these spots, one each side near the vein; apical fringes mostly black, no pale patches (in *hedeni* with pale patches). Hindwings mostly gray, with gray and black hair.

In forewings fork one is a little longer than its pedicel, fork two farther back on discal cell than in *hedeni*, fork three does not reach as far as apex of discal cell, fork four only a little before fork five.

In hindwings fork one is distinct, but small. In male genitalia the superior plate is broadly, deeply incised, and at each side is a fairly long incurved spine; the claspers are slender, the apical joint fairly long, tapering and but little curved, seen from behind the tip is forked, the penis stout, tip enlarged, and from above is an out-curved spine each side before the swollen tip, from the side the tip is seen to have three pointed projections above.

Forewing 7 mm. long.

Two from Szechwan, probably Suifu, taken with a mass of *H. hedeni*, which it resembles closely, except for the very different genitalia. Holotype, U.S.N.M. No. 53165. Paratype in M.C.Z.

H. rhomboana Martynov has a deeply incised superior plate but without the curved spines; the apical segment of the clasper is shorter and more curved.

HYDROPSYCHE PLANA Forsslund (?)

Three females from Wen Chuan Shien, 30 miles northwest of Kuanshien, August 26, 5,000 feet, and Mount Omei, July. These agree in size and are black, but a male would be necessary to be sure.

Genus HYDROMANICUS Brauer

HYDROMANICUS INTERMEDIUS Martynov

Three from near Washan, July, 4,000 to 6,000 feet, described from Szechwan.

Genus POTAMYIA Banks

POTAMYIA CHINENSIS Martynov

From Chengtu, September 1-3, Szechwan, known also from eastern China.

Genus ARCTOPSYCHE MacLachlan**ARCTOPSYCHE LOBATA Martynov**

Agrees generally with his figures, but the superior plate, which, as he figures, is divided into two long down-curved prongs, has on each side an elongate slender prong, not figured; the venation agrees. From Lu Ding Chiao, July 12-14, 4,000 to 9,000 feet; Chin Chi Shien, west of Yachow, July 10, 4,500 to 6,000 feet; near Washan, 4,000 to 6,000 feet, July, Szechwan; and Jedo Pass, China-Tibet border, July 17, 12,000 to 15,000 feet.

Genus PLECTROCNEMIA Stephens**PLECTROCNEMIA species**

A fairly large female from Mount Omei, forewing 12 mm. long; pronotum yellow-haired in middle, black on sides, and much black hair back of each eye.

PLECTROCNEMIA species

From near Washan, July, 4,000 to 6,000 feet, and Suifu, August; forewing 10 mm. long, both females; it has very little black hair on vertex and pronotum, but much yellow.

Genus PHILOPOTAMUS Curtis**PHILOPOTAMUS SINENSIS, new species****PLATE 29, FIGURES 44, 46**

Body dark brown to nearly black, head with yellow and some black hair, thorax also; antennae with a pale band at tip of most joints below; palpi with tuft of long, pale hair at lower outer end of first joint; legs pale, femora more or less darkened, spurs as usual. Forewings dark brown, clothed with short black hair, except on the numerous hyaline spots, many scattered small spots of golden hair, particularly in the anal region; hindwings gray, with short black hair.

In forewings the discal cell is not one-half of the pedicel, fork one about one-half of pedicel, fork two is back a short distance on discal, fork three a little longer than four, both short, latter nearly twice as long as pedicel, fork five back a little before discal cell; each of the four cross veins of the anastomosis separated from next.

In hindwings fork one also very short, fork two back nearly width of discal cell, fork three much longer than pedicel, fork five before base of discal cell. Male genitalia from side show a long slender apical part to the lower appendages, longer than the preceding part; above is a short median piece, and below a much longer median piece,

deeply bilobed at tip, each side is a short 2-jointed appendage, the apical part rounded and bent downward.

Forewing, length 8.5 to 11 mm.

From Wenchau, November–December; Jedo Pass, July 17–18, 12,000 feet (holotype); and O-Er, north of Li Fan, 9,000 feet. Holotype, U.S.N.M. No. 53166. Paratype in M.C.Z.

Family PHRYGANEIDAE

Genus EUBASILISSA Martynov

EUBASILISSA TIBETANA Martynov

One from Tang Gia, August 3–6, 14,000 feet, Tibet, agrees with a paratype.

Family LIMNEPHILIDAE

The genera of Limnephilidae known to me from China can be tabulated as below:

- | | | |
|--|-------|--------------------------|
| 1. Subcosta of forewings ends in a cross vein at base of the stigma | ----- | Apatania |
| Subcosta ends in margin | ----- | 2 |
| 2. No fork three in hindwings | ----- | Halesinus |
| Fork three present | ----- | 3 |
| 3. Vertex, pronotum, and wings with short, appressed hair, no upright bristles | ----- | 4 |
| Vertex and pronotum at least with erect hair and bristles, or else plainly on wings and veins | ----- | 5 |
| 4. Outer margin of forewing plainly sinuate | ----- | Glyphotaelius |
| Outer margin not sinuate | ----- | Nemotaulius |
| 5. Head smooth, ocelli exceedingly small, as also posterior warts | ----- | Evanophanes |
| Head with bristles, ocelli distinct | ----- | 6 |
| 6. No spines under last joint of hind tarsus; no ocellar macrochaetae; not four spurs to hind tibiae | ----- | 7 |
| Some spines under last joint of hind tarsus; four spurs to hind tibiae | ----- | 9 |
| 7. Palpi extremely long in both sexes | ----- | Nothopsyche |
| Palpi of usual length | ----- | 8 |
| 8. Base of fork one very broad | ----- | Psilopterna |
| Base of fork one acute | ----- | Platyphylax |
| 9. No ocellar macrochaetae | ----- | Pseudostenophylax |
| Ocellar macrochaetae distinct | ----- | 10 |
| 10. Apical margin oblique; in hindwing fourth apical cell narrowed at base | ----- | Limnephilus |
| Apical margin rounded; in hindwing fourth apical cell broad at base | ----- | Anabolia |

Genus GLYPHOTAEIUS Stephens

GLYPHOTAEIUS MUTATUS McLachlan

From Beh Luh Din, 30 miles north of Chengtu, August 13, 6,000 feet, and also from Kuanshien.

Genus **LIMNEPHILUS** Leach**LIMNEPHILUS SUBFUSCUS** Ulmer

One male from near Washan, Szechwan, July, 4,000 to 6,000 feet; another without definite locality, July 12–19, 13,000 feet. It does not differ in coloration or genitalia from Japanese specimens.

Genus **NOTHOPSYCHE** Banks**NOTHOPSYCHE RHOMBIFERA** Martynov

One female, apparently belonging to this species, from Chengtu, Szechwan, 1,400 to 4,500 feet. It has femora of front and midlegs pale yellowish, while in the male types the legs are said to be black.

EVANOPHANES, new genus

A large, broad-winged limnephilid, in general resembling a large *Dicosmoecus*, the venation similar except that fork one goes back much farther on the discal cell; hind tarsi broken, but, judged from the tibiae, with few if any spines, none on last joint of front tarsi, front tibia with one spur, hind tibia with two spurs, midlegs off.

Palpi (of female) very much longer than in *Dicosmoecus* or *Astenophylax*; head quite different from both and all other limnephilids in that the ocelli are extremely minute, hardly to be seen; the basal joints of antennae are wide apart, and the median ocellus occupies hardly one-tenth of the space, the lateral ocelli longer transversely; the face longer than in *Dicosmoecus*, no submedian grooves, but the lower pits present, no warts nor bristles on face; the vertex broadly convex, the posterior warts present, transverse, but extremely small, each with a few very short black bristles, no other bristles on vertex; antennae much like *Dicosmoecus*. Mesothoracic strips also very short and narrow.

Type, *E. insignis*, new species.

Readily distinguished by the very small ocelli, lack of grooves and warts on face, and of bristles on the vertex. *Stenophylax magnus* has the ocelli smaller than in many limnephilids, but not comparable to these; moreover there are the usual bristles on face and vertex.

EVANOPHANES INSIGNIS, new species

PLATE 30, FIGURE 71

Body bright reddish, antennae, palpi, and pronotum black, also a square spot on the mesoscutellum is black, femora pale, rest of legs black. Forewings a uniform brown (darker than in *Dicosmoecus atripes*), a small hyaline spot on the thyridium, membrane evenly clothed with short black hair, veins with longer, erect hairs. Hind-wing paler, but brownish in front and at tip. Venation of forewing much as in *Dicosmoecus* or *Astenophylax*, but fork one is back on

discal cell for more than width of the cell; fork three also back for about a cell's width. In hindwing fork one is also back on discal cell more than width of cell.

Length of forewing, 32 mm.; width, 11 mm.

One specimen of this fine large species from near Washan, Szechwan, China, 4,000 to 6,000 feet, July. Type, U. S. N. M. No. 53167.

Genus PLATYPHYLAX McLachlan

PLATYPHYLAX RUBESCENS Martynov

PLATE 29, FIGURE 40

Described from a female from Yatung, Tibet. Two females agree fairly well with the description and figure. The males have very striking genitalia. The tip of the last abdominal segment is bent down in a broad lobe, which is covered with stout black spines; below (from side) is a pale elongate superior appendage, and below this the intermediate hooklike processes, its tip (seen from side) has a slender inner prong and a rounded outer lobe; from below are two broad truncate lobes, each tip with stout hairs, and above these are two curved reddish spinelike pieces, with a long tooth near tip and another not quite so long nearer to base, seen best from behind.

In most of the males the wing membrane is slightly brownish and with many small pale spots; hair on face largely yellowish, black each side by eyes, those on vertex mostly pale, but some black each side, those on mesonotum mostly pale, a few of those over wing base are darker or nearly black.

Specimens are from 9 miles southwest of Tatsienlu, June 25-27, 8,500 to 13,000 feet; O-Er, 26 miles north of Li Fan, August 16; Yachow, August 27-30 (all Szechwan); and Jeddo Pass, 12,000 to 15,000 feet, July 17, China-Tibet border, and Yiel Long Shien, August 3-6, 13,000 to 15,000 feet, China-Tibet border. *Pseudopotamorites peniculus* Forsslund appears to be very close to this species, but Forsslund's figures show slight differences in details. I see but little resemblance to *Potamorites*, but if *Platyphylax* is to be divided, the generic name may be kept.

Genus PSILOPTERNA Martynov

PSILOPTERNA SINENSIS, new species

PLATE 29, FIGURES 49, 50

Head and body pale yellowish, abdomen darker above toward tip; palpi, antennae, and legs pale, unmarked; hair on face pale, but some black each side by eye, that on vertex pale, that on thoracic notum pale, and above the wing base but little darker.

Forewings pale yellowish, a little darker in anal area and near cubitus, the outer margin also faintly darker, no distinct irroration;

hind wing also pale, veins and fringes pale yellowish. Forewings moderately slender, and the tip not broadly rounded; discal cell very long, widened near tip, upper margin toward tip concave; fork one not back on discal cell, but broad at base, fork two a little narrowed at base, fork three scarcely back on cell, anal cell very long, as long as width of wing at its end; all hairs very short.

Legs long and slender, with but few black spines, last joint of mid and hind tarsi with but few spurs, 0, 2, 2, front tarsus of male much longer than tibia, its basal joint only about one half as long as the second.

Male genitalia short and inconspicuous as in *Micropterna*; lower appendages shorter than in *P. pevzovi* Martynov, the upraised dark hooklike processes much less stout and with slenderer tips than in that species, the hind edge of the last dorsal segment roughened with minute teeth.

Forewing, male, 20 mm. long, 6 mm. wide.

Holotype, U.S.N.M. No. 53168. Paratype in M.C.Z.

A female differs in no important respects but is much larger, forewing 25 mm. long; the tip of abdomen shows two rather slender dark-tipped processes nearly their length apart.

From Beh Luh Din, Szechwan, August 22, 6,000 feet (holotype), and near Kuanshien, October 20. It is very similar to *Microptera indica* Mosely from Kashmir; the lower appendages are not so much narrowed toward tip, the upper lateral lobe larger, the tip of last segment has black spinules instead of the pale setae of *M. indica*, etc.

Genus PSEUDOSTENOPHYLAX Martynov

Pseudostenophylax shows traces of the bristle-bearing warts on metanotum and base of abdomen. In males of *P. grahami* are usually several of these warts in two rows on the metascutellum; in males of *P. (Trichophylax) monticola* there is a prominent median patch at the base of the intermediate segment, just behind the metascutellum. In *P. amplus* there are a few warts each side of the middle groove at base of the intermediate segment in both sexes. I do not find any in the other species.

The species of *Pseudostenophylax* from Szechwan known to me can be separated in the male sex as follows:

1. Abdomen with long hair above; discal cell very long; at base of intermediate segment, just behind the metascutellum is a patch of bristle-bearing warts..... *monticola*
- Abdomen with only the usual short hair, except a tuft or crest at tip..... 2
2. Discal cell more than twice as long as its pedicel..... 3
- Discal cell but little longer than its pedicel..... 6

3. Expanse 50 or more mm.; tip of abdomen without tuft of long hair, lower part of slope black with minute tubercles; at base of intermediate segment is a few bristle-bearing warts each side of the median groove----- **amplus**
 Expanse scarcely 40 mm----- **4**
4. Hind tibiae with a row of long, curved, white hairs behind, small species; crest of black hairs near tip of abdomen, above slope----- **minus**
 Hind tibiae without the long white hairs----- **5**
5. Tuft of long rufous hair near tip of abdomen above the slope; usually some bristle-bearing warts on the metascutellum----- **grahami**
 No tuft of long hair near tip of abdomen----- **difficilis**
6. Hind tibiae with long white hairs behind; median teeth broad and low----- **mimicus**
 Hind tibiae without the long hairs behind; median teeth high and more narrow----- **brevis**

P. szechuanensis Martynov I have not seen; the figures of genitalia appear different from any I have seen.

PSEUDOSTENOPHYLAX AMPLUS (McLachlan)

PLATE 29, FIGURES 35, 39

Described as a *Halesus*; a pair from 9 miles from Tatsienlu, the type locality, and Hai Tsi Ping near Tatsienlu, August 5, 13,000 feet. The male has four spurs to hind tibia, the female but three. They agree very well with the description in size and coloration. The male has a broad black area at tip, thickly studded with minute tubercles, and below it in the middle, apparently as part of the upper piece (but I do not think so) is a deep black horseshoe-shaped piece, each lower end bending out in a process, and apparently the part referred to by McLachlan. Seen from side, the clavate superior appendages hang down, and the intermediate are slenderer, the lower appendages curving upward and covering over half the genitalia.

The lower appendages from below are short on the inner edge, very long on outer side, the apical margin concave.

The female, from above, shows a broad median piece angularly notched in middle, each tipped with a slender finger; on each side of this central part is a broad rounded lobe, with an oval depressed hairy area; below this upper part is a broad pale lamina, its outer margin heavier, and broadly emarginate in the middle; below the latter is a still larger projection, the middle part pale, the broadly rounded almost projecting side lobes are black. From these genitalia it is evidently a *Pseudostenophylax* in the sense of Martynov; but the hindwings show no specialized hairs or scales in anal area; but there are many tubercles on the membrane and much long fine hair.

PSEUDOSTENOPHYLAX GRAHAMI Martynov

From Wei Chow, August 15, Szechwan; and Yu Long Gong, August 14, 14,000 feet, Tibet.

PSEUDOSTENOPHYLAX DIFFICILIS Martynov

From Chin Chi Shien, west of Yachow, July 10, 4,500 to 6,000 feet; others from Yellow Dragon Temple (type locality) July 25, 11,000 to 14,000 feet, and Hai Tsi Ping, near Tatsienlu, August 5, 13,000 feet.

PSEUDOSTENOPHYLAX MINIMUS, new species

PLATE 28, FIGURE 31; PLATE 29, FIGURE 36

Body brown, abdomen above dull black, the longer hairs and bristles are black, some long ones on pronotum are paler, and the short, more appressed hair on face and vertex is pale; basal joint of antennae brown, with black hairs, beyond paler; palpi brown; legs pale, with short black spines, hindtibia of male curved, and with a row of long, slightly curved hairs on hind edge.

Forewings pale brown, with scattered pale spots, not often connected, few pale spaces in costal area, membrane with short black hair, those on the veins not much longer, except in anal area; hindwings pale gray, hardly darker at tip. Forewings in shape like *grahami*, discal cell more than twice as long as the pedicel, its upper edge before fork one is concave, latter back on the discal cell about width of the cell. In hindwings no apparent scales, in anal area an elongate deep pouch, costal area very broad.

Tip of abdomen has a long sloping area, brown, and with very short curved hairs, above is a tuft or crest of long black hairs; below are the two median teeth, large, and quite long with narrowed and rounded tips, mostly black; the lower appendages are moderately long, seen from below long on the outer side, very much shorter on inner side, the tip concave, and provided with many very long bristles.

Length of forewings, 13 mm.; width, 5 mm.

One from near Washan, 4,000 to 6,000 feet. Holotype, U.S.N.M. No. 53169.

Differs from *P. brevis* by less broad wing, longer discal cell, ciliate hind tibia, and shape of the median teeth.

PSEUDOSTENOPHYLAX MIMICUS, new species

PLATE 29, FIGURES 42, 45

Greatly resembling *P. minimus*, of same size and general coloration; the forewings are more pale, better described as pale, marmo-

rate with pale brown, more or less connected spots. In forewings (both sexes) the discal cell is but little, if any longer than its pedicel, and its upper edge is not concave before fork one, and the latter does not go back so far on the discal cell; in the hindwing the costal area is fully as broad as in *minimus*, and in male there is the same elongate pouch near anal margin.

The tip of abdomen of male has a tuft of black hair above, below a large sloping area clothed with short bristles, this area is paler than in *minimus* but with dark outer corners; the median teeth are low and very broad (quite unlike *minimus*); the lower plates are small.

The hind tibia has the same long, curved, white hairs as in *minimus*. The tip of the abdomen of the female, from above, shows the usual two spinelike processes very far apart and curved toward each other.

Length of forewing of male, 13 mm.; width, 5 mm.; the female scarcely larger.

From Suifu, 1,000 to 2,000 feet, August 1928. Holotype, U.S.N.M. No. 53170. Paratypes in U.S.N.M. and M.C.Z.

PSEUDOSTENOPHYLAX BREVIS, new species

PLATE 29, FIGURES 34, 41, 43

Body brown, thoracic notum paler through the middle; erect hair mostly black, some appressed hair on face and vertex yellowish; antennae with basal joint dark brown with black hair, beyond paler; palpi pale brown; legs pale with black spines, not very long. Forewings brown, with many scattered pale spots, none very large, and mostly not connected, few in costal area, hyaline thyridial spot rather large; membrane with short black hair, veins with longer hair, especially the anal veins. Hindwings pale gray, slightly darker toward tip.

Forewings very short and broad, broadly rounded at tip, costal margin convex, discal cell not as long as usual, but little longer than pedicel, fork one not width of discal cell back on discal; apical cells two and four about equal at base, forks two and three indenting the anastomosis but little; hindwing with no scales visible, but a deep elongate pouch in anal area. Tip of male abdomen shows the usual sloping area, very broad, brown, covered with appressed bristles, above it is a broad tuft of black hair; below it are the two median teeth, large, broad, truncate at tip, black at their margins, below it the two processes directed toward each other, and tipped with stiff reddish bristles; the lower appendages or plates are broad and short, longer on outer edge.

In the female the tip of abdomen from above shows two rather broad, somewhat quadrangular plates, each with a long curved spine.

Length of forewing, female, 12.5 mm.; width, 5 mm.

Length of forewing, male, 11 mm.; width, 4.5 mm.

Two from near Washan, 4,000 to 6,000 feet, July. Although the discal cell is short in this and *P. mimicus*, I keep them in this genus because they are very closely related to *P. minimus*, which has a long discal cell. Holotype, U.S.N.M. No. 53171. Paratype in M.C.Z.

PSEUDOSTENOPHYLAX (TRICHOPHYLAX) MONTICOLA, new species

PLATE 29, FIGURES 37, 38, 51

Face rufous, with black hair; vertex nearly black, also with black hair; basal joint of antennae pale and with pale hair, beyond the segments are darkened above; palpi pale, second and third joints equally long, mesonotum black on sides, more rufous through middle, hair black; metanotum rufous, darker above wing base; abdomen dull brown above, with innumerable distinct pits, larger than usual, and each with a long white hair, about one third as long as the segment, a few near middle of length longer, at tip a tuft of long hair as usual; venter more yellowish; legs pale, front and mid tibiae with black spots, and the tips of tarsal joints dark, many black spines.

Forewings rather densely clothed with short black hair, posterior part of wing from cubitus back is brown, and with some pale spots, one much larger near end of anal cell; apical veins with irregular brown spots along each side; hindwings with short black hair in front, paler behind, fringes short and pale.

Forewings rather short and broad toward tip (much like *T. rotundipennis*), fork one is back on discal cell about twice as far as in *T. rotundipennis*, fork three also reaching farther back; discal cell even longer, its pedicel no longer than cell width, and the discal cell not widened at tip. Male genitalia show below a rather long piece each side, obliquely truncate, and with long yellowish hair; the superior pieces (from side) are short and moderately broad, not pointed, the intermediate appendages have a pair of slightly curved slender black prongs directed upward; the penis sheaths have the terminal piece slender, curved, and with long hair at tip (like *Pseudostenophylax*); tip of last dorsal segment with a triangular depressed area, covered with minute black denticles. Tip of female has the two slender tipped pieces common in *Pseudostenophylax*, only slightly separated; these arise from a rather large base, and below (from side) is an elongate lobe, and at lower side, an elevated ridge, projecting most prominently below. The hairs on the abdomen of the female are only a little longer than usual in the family.

Length of forewing, 17 to 22 mm.; width, 7 to 8.5 mm.

From 9 miles southwest of Tatsienlu, June 23-27, 8,500 to 13,000 feet (holotype); 30 miles north of Tatsienlu, July 9-19, 1,200 feet; near Moupin, July 22-24; Wei Chow, 65 miles north of Chengtu, August 15, 9,000 to 12,500 feet (all in Szechuan). Holotype, U.S.N.M. No. 53172. Paratypes in U.S.N.M. and M.C.Z.

Although this species, as far as genitalia are concerned, agrees better with *Pseudostenophylax*, I place it near *Trichophylax*, since it has no specialized hairs or scales on the hindwings, and the hairs above on abdomen are very much longer than I have seen on any other limnephilid. These hairs, however, are not so long as Mosely figures for the genotype; it differs in the genitalia, in longer first apical fork, in the male palpi, etc.

This is very close to *Pseudostenophylax hirsutus* Forsslund from Kansu Province. His figure shows the terminal pieces of the penis sheath shorter and bent, and the lower appendages, although triangular, are not so long as in *monticola*. His name *hirsutus* would be very apt, but he does not say the hair is longer than usual, only that it is quite dense or thick.

Genus HALESINUS Ulmer

HALESINUS FENESTRATUS, new species

PLATE 29, FIGURE 53

Black; clothed mostly with black hair, some yellow on face, vertex and mesonotum with numerous black hairs with yellow tips; tarsi black, femora and tibiae more or less pale brownish, hind tibiae especially pale. Forewings dark brown to nearly black; costal area with transverse pale marks much like *H. tenuicornis*; in anal area two oblique white marks, nearly parallel, basal one usually broken (in *tenuicornis* divergent), around outer margin with white spot in each cell, and extended in white on the otherwise black fringe; a few small patches of white scattered over wing, and at the anastomosis, just before and a wide area beyond, is a large pale area, clothed with white and golden hairs, the anastomosis and apical veins remain dark. Hindwings gray, costal tip darker, veins dark, outer fringe nearly black.

Venation much as in *tenuicornis* and *albopunctatus*, but in forewing the discal cell is not twice as long as its pedicel, and in hindwing fork one does not extend back on the discal cell (considerably so in other species). Forewings with outer margin distinctly crenulate.

Length of forewing, 12 mm.; width, 4 mm.

Two females without definite locality, except Szechwan, 13,000 feet, July 9-12.

Readily distinguished by the large pale area at anastomosis; *H. ussuriensis* is also separated by the very long discal cell. Holotype, U. S. N. M. No. 53173. Paratype (no head) in M. C. Z.

HALESINUS ALBOPUNCTATUS Martynov

From near Yien Long Shien, August 3-6, 13,000 to 15,000 feet; Yin Kuan Tsai, July 25, 13,000 to 15,000 feet; and Jedo Pass, July 13, 12,000 to 15,000 feet, all on China-Tibet border.

HALESINUS TENUICORNIS Ulmer

From Wen Chuan Shien, July 26, 5,800 feet; Hai Tsi Ping near Tatsienlu, August 5, 13,000 feet; near Moupin, July 22-24; O-Er, north of Li Fan, 9,000 feet; Bul Lau Tsen, northeast of Li Fan, July 31, 8,500 feet; 9 miles southwest of Tatsienlu, June 25, 8,500 to 13,000 feet (all Szechuan); and Jedo Pass, July 17, 12,000 to 15,000 feet, China-Tibet border.

Family CALAMOCERATIDAE

Genus **PSILOTRETA** Banks**PSILOTRETA CHINENSIS**, new species

PLATE 27, FIGURE 1; PLATE 30, FIGURES 67, 68, 70

Head and thorax reddish brown, abdomen dull black; face with yellowish hair, vertex and thorax above with short gray hair; palpi brown; antennae pale, basal joint darker, legs pale yellowish, with fine whitish hair, spurs pale.

Forewings brownish gray clothed with golden and black hair, the latter short and hidden by the golden; hindwings gray, with black hair. In shape and venation the forewings are similar to *P. japonica*, the discal cell is rather longer and slenderer, fork one is much longer, reaching back more than halfway on discal cell; fork two with a moderate pedicel, fork three quite short, fork five a little widened near base.

Tip of abdomen of female (from above) shows two emarginate lobes, the shorter one above the other. The male genitalia are rather complicated. Above is a median triangular superior plate, beyond its tip is a slender peniscover, and the penis, the latter deeply bilobed at tip; from each lateral side or tip of the abdomen is a moderately long and broad, extremely hairy appendage, from its inner tip projects a dark bar toward the tip of superior plate, at its upper tip is a curved spine, also a curved spine at inner tip of the lateral appendage, but hidden in the long hair. Between these median and lateral parts is a dark, 3-pointed piece, the outer and inner processes tapering to a long, slender-curved point, one of which projects downward and is seen from the side.

Length of forewing, male, 12 mm.; female, 15 mm.

From near Washan, Szechwan, July, 4,000 to 6,000 feet, several specimens. Holotype, U.S.N.M. No. 53174. Paratypes in U.S.N.M. and M.C.Z.

The male genitalia have the superior plate and the lateral appendages very much shorter than in *P. kwantungensis* Ulmer, and the lower appendages (from side) are very broad throughout, and the wings are a uniform brownish, without the white hair of *P. kwantungensis*; I have a male of the latter species from Yim Na San, East Kwantung (Gressitt coll.).

Family LEPTOCERIDAE

Genus NOTANATOLICA McLachlan

NOTANATOLICA LEGENDRINA Navás

Several from Chengtu, July 3-5, 1,700 feet, Szechwan, and one from near Tsao Tong, July 12, Yunnan. It was described from Yunnan.

Genus OECETIS McLachlan

OECETIS TURBATA Navás?

A female from Chengtu, July 3-5, may belong to this species of eastern China; the spots at forks are the same, but the apical part is more evenly dark; a male might show it different.



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CESTOCRINUS, A NEW FOSSIL INADUNATE CRINOID GENUS

By EDWIN KIRK

IN 1934¹ I described the new crinoid genus *Corynecrinus*, for the reception of which and one other genus (*Lecythocrinus* J. Müller) I proposed the family Lecythocrinidae in the order Inadumata. Both genera are of Devonian age, one from Europe and one from the United States. I am now able to add another genus to this family, coming from the Mississippian (upper Borden) of Indiana.

CESTOCRINUS, new genus

Genotype.—*Cestocrinus striatus*, new species.

Generic diagnosis.—

Crown. Subcylindrical.

Dorsal cup. Campanulate to urn-shaped.

IBB. Five. Large, approximately one-third the height of the dorsal cup.

BB. Of medium size, except post B, which is very large, extending to the level of the arm bases and supporting two tube plates.

RR. Relatively small. Arm facets elevated above level of plates, horseshoe-shaped, and approximately one-half width of radial at that level.

Arms. Relatively slender, composed of subcylindrical, long Br. Number of IBr variable: 3 in l ant R; 4 in r ant R; more than 4 in ant R in type species.

¹ *Corynecrinus*, a new Devonian crinoid genus. Proc. U. S. Nat. Mus., vol. 83, pp. 1-7, 1 pl., 1934.

Post IR. No anal plates in cup. The entire area of the post IR up to the level of the arm bases is occupied by the hypertrophied post B. Resting on the distal faces of this B are two large plates which can be considered only as tube plates.

Ventral sac. Judged from the proximal portion of the ventral sac as preserved, the tube was relatively slender, subcylindrical in shape, and composed of fairly large plates.

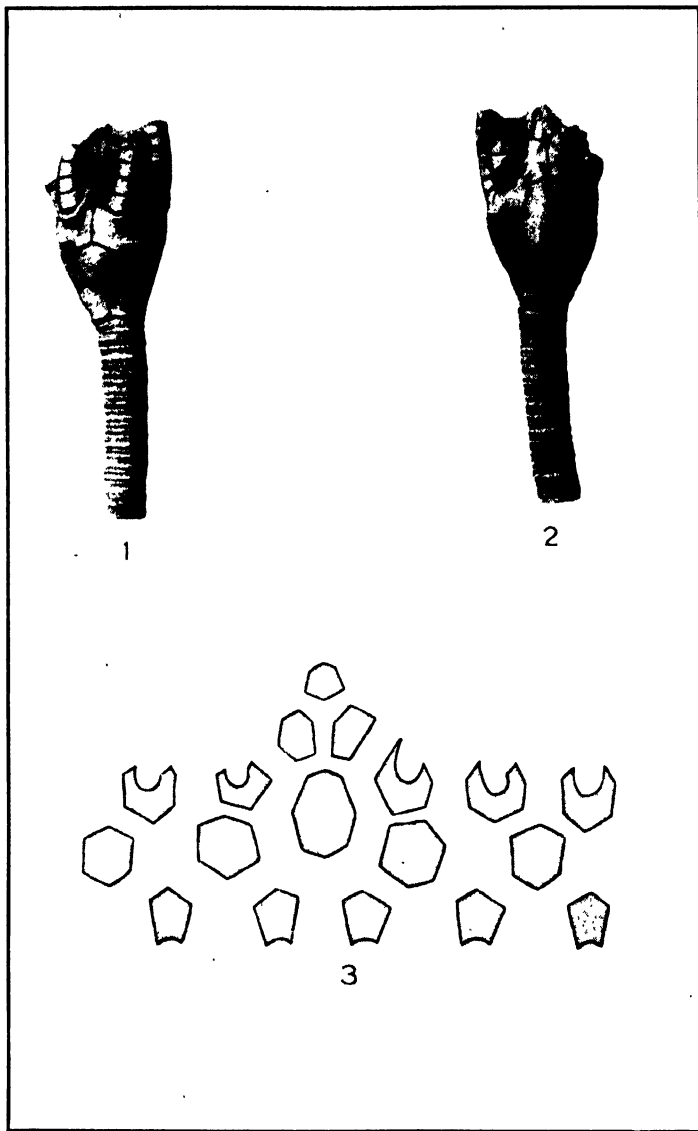
Column. Stout, circular in section, composed of alternate nodals and internodals. Lumen large, outline indistinct in polished section but apparently pentagonal.

Species. The only known species referable to *Cestocrinus* is the new species *C. striatus*, here described.

Geologic and geographic distribution.—The type species was found in the upper Borden (Mississippian, lower Carboniferous) of Indian Creek, Montgomery County, Ind.

Relationships.—The peculiar structure of the posterior interradius, together with similarities of arm structure and general resemblance, seems clearly to ally *Cestocrinus* with *Lecythocrinus* Müller and *Corynecrinus* Kirk. Of the two formerly described genera, *Cestocrinus* more nearly resembles *Corynecrinus*. The two genera differ in well-marked structural characters. In *Corynecrinus* the post B is but slightly larger than the other BB. In *Cestocrinus* the post B is very large, reaching to the level of the arm bases. In *Corynecrinus* the IBB are very small and scarcely visible in lateral view. In *Cestocrinus* the IBB are large, approximately one-third the height of the cup. The arm-bases in *Cestocrinus* are sharply elevated above the level of the RR and are relatively narrower than in *Corynecrinus*. As seen, there are many more IBr in *Corynecrinus* than in *Cestocrinus*. In *Corynecrinus* the two proximal tube plates lie well down in the cup, and the tube plates of the second range rest on the upper sloping shoulders of the r and l post RR. In *Cestocrinus* the pair of proximal tube plates have been raised above the level of the cup and rest on the upper sloping shoulders of the r and l post RR.

The persistence of this tenuous genetic crinoid line from the Middle Devonian well up into the lower Mississippian is very interesting. *Cestocrinus* shows no resemblance to any known Carboniferous inadunate genus, and one must cast back into the Middle Devonian to find like structural forms. At all times members of the family seem to have been exceedingly few in number. *Lecythocrinus* is represented by a few specimens. *Corynecrinus* is known from but a single specimen. *Cestocrinus*, also, is based on a unique specimen. Since many thousands of crinoids have been collected at Crawfordsville and Indian Creek, Ind., as well as from approxi-



CESTOCRINUS STRIATUS, NEW GENUS AND SPECIES.

1, Anterior view.

2, Posterior view.

3, Plate diagram.

mately equivalent horizons elsewhere, the form must be exceedingly rare. The lack of a known antecedent form in the great crinoid collections of the Burlington is significant.

CESTOCRINUS STRIATUS, new species

PLATE 31

The description is based on a perfect dorsal cup with the arms preserved in part to a length of 10 mm. and with about 25 mm. of column attached. The proximal portion of the ventral sac is also present. The specimen has been freed from the matrix.

The dorsal cup is narrowly campanulate in form and composed of fairly thin plates. The surface of the plates is finely papillose, the papillae tending to become confluent in linear series, thus forming striae normal to the faces of the plates. Low folds pass from radial to radial, radials to basals, and basals to infrabasals. The dorsal cup has a height to the arm bases of approximately 15 mm. and an average maximum diameter of about 14 mm.

The IBB are five in number, pentagonal in outline, with an average height of 4.3 mm. and an average maximum breadth of about 5 mm. The BB, with the exception of the posterior, are hexagonal in outline, having an average height of 7.3 mm. and an average maximum breadth of 6 mm. The posterior basal is octagonal in outline and has a height of 11.3 mm. and a maximum breadth of 7.8 mm. The distal point of the post B lies at approximately the plane of the arm bases. On its distal sloping faces the post B supports the two proximal tube plates. The RR are relatively small, having an average height of 5.2 mm. and an average maximum width of 6.3 mm. The arm facets are horseshoe-shaped, approximately one-half the width of the radials at that level, and stand out sharply above the surface of the plates.

The arms are proportionally slender and composed of relatively long, subcylindrical brachials. The primibrachs have an average width of 2.6 mm. In the r ant R there are four IBr and in the l ant R three IBr. In the ant R four IBr are shown without an axillary, which follows the common rule among inadunate crinoids that the ant R tends to carry more primibrachs than the other rays.

The ventral sac, judged from the proximal portion preserved, was subcylindrical in shape, proportionally slender, and composed of rather large, heavy plates. The proximal tube plates are very large, that to the right having a height of 7.5 mm. and that to the left 6.5 mm. The tegmen was composed of a flexible integument of small nodose and rugose plates.

The column is large, having a diameter in the proximal portion of 5.6 mm. This measurement allows for slight crushing. The stem lumen does not show clearly in the polished face of the column. It is large, having a diameter of approximately 2.3 mm. at a distance of 25 mm. from the cup. It seems to be pentagonal in outline. The column is composed of alternate wider and narrower columnals. These, in turn, are grouped into larger series of nodals and internodals which differ little from one another in size.

Horizon and locality.—The type and only known specimen was collected from the well-known locality on Indian Creek, Montgomery County, Ind., by Fred Braun in 1909. The horizon is upper Borden.

Type.—The holotype is in the Springer collection, U.S.N.M. No. S-4293.



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NOTES ON SOME PEDUNCULATE BARNACLES FROM THE NORTH PACIFIC

By DORA PRIAULX HENRY

UNTIL recently it was generally assumed that the species of barnacles of the genus *Lepas* were easy to identify, but Nilsson-Cantell (1921, 1928), Hiro (1937), and several others have shown that some, at least, are extremely variable. Until some worker is able to examine and compare specimens of the different species from all over the world, some progress may be made in overcoming the difficulties encountered in identifying the species of this genus if descriptions and figures of the specimens of different regions are published.

The barnacles to be described in this paper include an atypical form of *Lepas anatifera*, a new subspecies of *L. pectinata*, *L. fascicularis aurivillii*, *Scalpellum columbianum*, and *Mitella polymerus*. The specimens of *Lepas* and *Scalpellum* were collected from several localities between Alaska and Oregon. I am indebted to Prof. Trevor Kincaid, Department of Zoology, University of Washington, and to the College of Fisheries, University of Washington, for allowing me to examine specimens in their collections. *Mitella polymerus* was collected from Puget Sound, Wash., Oregon, California, and Lower California. Pedunculate barnacles from the North Pacific have previously been reported by Pilsbry (1907) and Broch (1922).

Genus LEPAS Linnaeus

LEPAS ANATIFERA Linnaeus

FIGURE 1

Synonymy: See Nilsson-Cantell, 1921, p. 236.

This is one of the most variable species of the genus *Lepas*. The number of filamentary appendages, i. e., one at the bases of the first cirri and one on the prosoma on each side, is the most reliable criterion in differentiating this species from the closely related species, *L. hillii*. Darwin states that the presence of a tooth beneath the umbo, on the right-hand scutum, and its entire absence on the left constitute an unfailing diagnostic mark. Weltner (1900) found otherwise typical

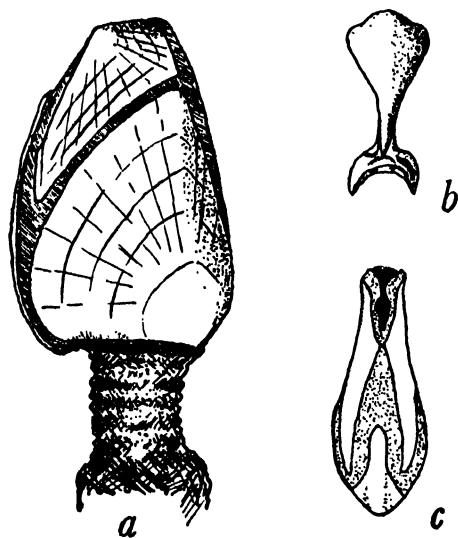


FIGURE 1.—*Lepas anatifera* from Harriet Harbor, British Columbia: *a*, Side view, $\times 2$; *b*, carina, external view, $\times 3$; *c*, apex of capitulum from above, $\times 3$.

L. anatifera with an internal tooth on the left-hand scutum as well. Nilsson-Cantell (1928) examined specimens that Cornwall (1925) identified as *L. hillii* from British Columbia and found an internal umbonal tooth on both scuta. In 1931 this author also described an atypical form, the scuta of which have no umbonal teeth. The absence of umbonal teeth is also one of the diagnostic characters of several varieties; subspecies *indica* Annandale (1909) has an internal umbonal tooth on the left-hand scutum only. Therefore it can be seen that this character is an extremely variable one.

Miranda y Rivera (1921) proposed a new species, *L. maroccanus*, with the following characters: Plates smooth; carina slightly curved

and separated from the other plates by a wide membrane; fork with two long and diverging branches; internal umbonal tooth on each scutum; and two filamentary appendages on each side. As the only real difference between this species and *L. anatifera* is the presence of teeth on both scuta and as this character is variable, *L. marocannus* must be considered a synonym of *L. anatifera*, and until a more comprehensive study is made of this species it does not seem advisable to call it a variety.

The specimens described below were obtained from six localities between Willapa Harbor, Wash., and the Aleutian Islands, and all have an internal umbonal tooth on both scuta.

Description.—The scutum is radially striate. The ridge from the umbo to the apex is never very prominent and in some can scarcely be seen. The occludent margin is nearly straight. The internal tooth of the right scutum is usually larger than that of the left. The internal basal rim does not quite reach the carinal border. The carina is separated by a rather wide interspace from the other valves; the apex is rounded; the greatest width is at the middle, and the narrowest part is just above the fork. The fork is narrower than the widest part of the carina; the rim between the prongs is reflexed. A thick membrane borders the occludent margins of the scuta and terga. The two occludent margins of the terga are nearly at right angles to each other.

The peduncle varies in length in proportion to the length of the capitulum. In young specimens tiny spines occur on the surface as described by Darwin for the young of *L. australis*. In older specimens no spines were found, but there are irregular chitinous plates scattered over the peduncle. There are two filamentary appendages on each side. The mouth parts and cirri do not differ from those of typical *Lepas anatifera*. The caudal appendages are small and rounded at the apex.

Size.—In the largest specimen the capitulum is 43 mm. in length and 28 mm. in width, and the peduncle is 50 mm. in length and 13 mm. in width (dry specimen, Willapa Harbor).

Localities.—Willapa Harbor, Wash., July 15, 1938, on limb washed on shore. Harriet Harbor, Moresby Island, British Columbia, July 29, 1934, on kelp with *L. pectinata pacifica*. William Head, Vancouver Island, British Columbia, 1926, from ship's bottom. Friday Harbor, Wash., July 14, 1937, on floating board with *L. pectinata pacifica*. Lousonne Harbor, Queen Charlotte Island, British Columbia, February 11, 1935, on floating bottle. Aleutian Islands, 1936.

LEPAS PECTINATA PACIFICA, new subspecies

FIGURES 2, 3

Holotype.—U.S.N.M. No. 78233, from Harriet Harbor, British Columbia.

Diagnosis.—Valves brittle and radially striate. No internal umbonal teeth. Ridge from umbo to apex of scutum close to occludent margin. Occludent margin of tergum single. Tergum notched to receive apex of scutum. One short blunt filamentary appendage on each side. No caudal appendages.

Description.—The capitulum is rather thick basally. The plates are white and the surface shows fine radial striations. The growth ridges

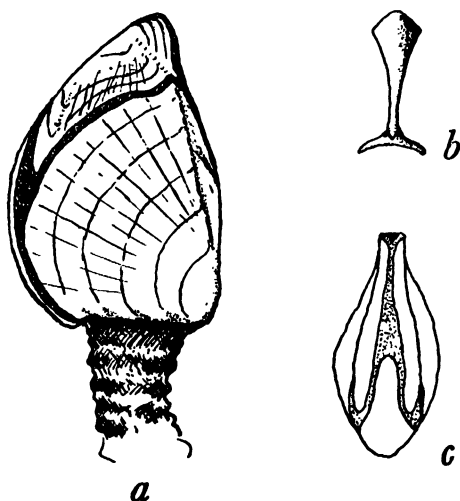


FIGURE 2.—*Lepas pectinata pacifica*, new subspecies, from Harriet Harbor, British Columbia: *a*, Side view, $\times 2$; *b*, carina, external view, $\times 3$; *c*, apex of capitulum from above, $\times 3$.

are more or less prominent and uneven, particularly on the tergum. The plates are very thin and brittle but the edges are not sinuous.

The scuta are subtriangular, with the apex somewhat pointed. Toward the base they are concave internally. The occludent margin is straight, and the ridge from the umbo to the apex is prominent and never more than 1.5 mm. from the occludent margin. The basal margin is not straight but projects downward at the umbo. There is a slight internal basal rim and in most a thickening externally on the basal margin. There are no internal umbonal teeth.

The tergum is triangular and has a notch, usually very conspicuous, on the scutal margin very close to the occludent margin. The occludent margin of the tergum (fig. 2, *c*) differs from that of the typical form in that it is restricted to a single side of the tergum instead of

to two sides (compare with fig. 1, *c*). In this respect *L. pectinata pacifica* resembles *L. fascicularis*.

The carina extends about halfway between the terga. It is rounded at the apex and is approximately the same width until just above the fork, where it is slightly narrower. The fork is a little wider than the carina, and the prongs, which are thin and pointed, diverge at an angle of approximately 180° as in the typical form. The rim between

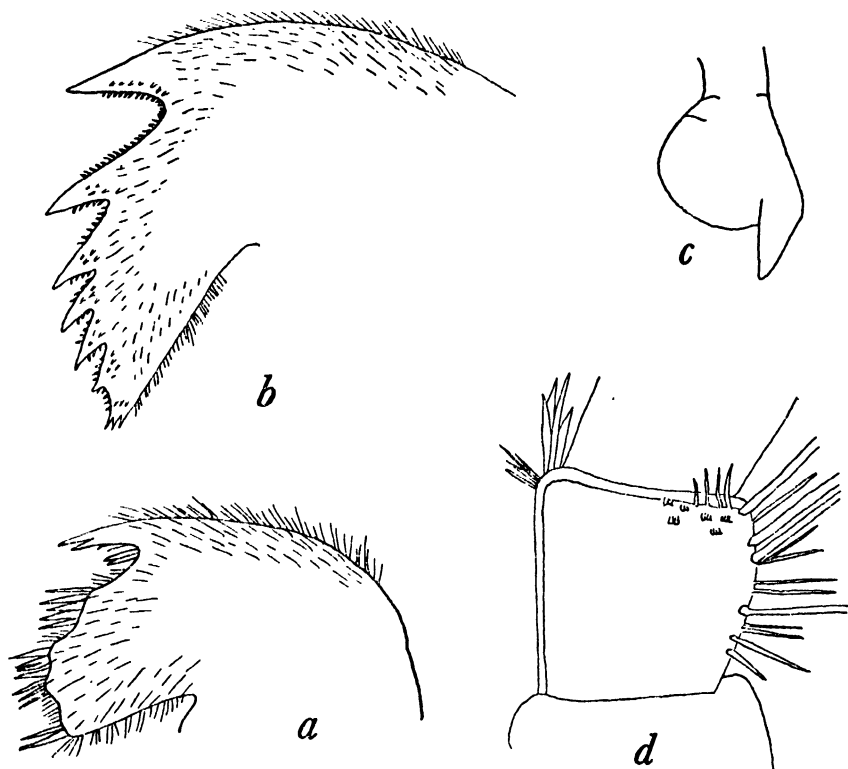


FIGURE 3.—*Lepas pectinata*: *a*, Maxilla, $\times 31$; *b*, mandible, $\times 31$; *c*, filamentary appendage, $\times 64$; *d*, middle segment of cirrus VI, $\times 7$.

the prongs is not reflexed. The fork is not deeply embedded in the membrane.

The peduncle varies in length and unlike the typical form is often longer than the capitulum. It is smooth, and no spines occur on the peduncle of young individuals.

One filamentary appendage occurs posteriorly at the base of each first cirrus (fig. 3, *c*). They do not develop until the capitulum is about 7 mm. in length and at first are extremely small. In larger individuals they are short and thick with a blunt end.

The mouth parts, particularly the maxillae and mandibles (figs. 3, *a*, *b*), are variable as in the typical form. The palpi are narrow at

the ends and swollen at the point of attachment to the labrum. The mandibles have five or six teeth and the inferior angle, which is bordered by several long spines, may be either single or divided into two points. The surface is hairy, and small spines occur on both edges of the teeth as well as on the surface. The maxillae have two or three large unequal spines, usually followed by three steps with the lower one wider and frequently showing a small notch in the middle. In some there are four steps below the large spines. The outer maxillae have long hairs on the inner surface near the edge.

The first cirrus is set a little apart from the posterior cirri. The rami are unequal, 12 segments in the anterior and 11 in the posterior one, with the middle segments of each very slightly protuberant.

The posterior cirri (fig. 3, *d*) have six or seven pairs of spines with smaller intermediate spines on the anterior border and three to five thick spines and a few fine spines on the posterior distal angle. On the distal border there are multifid spinules and a few longer single spines, particularly near the anterior border. There are about 25 segments in each ramus.

No caudal appendages occur, but in some individuals the membrane on each side of the anus is somewhat swollen. The penis varies in length from half the length to a little longer than the sixth cirrus and is very hairy.

Size.—The largest specimen seen was from Harriet Harbor and had a capitulum 20 mm. in length and 14 mm. in width and a peduncle 16 mm. in length and 5 mm. in width.

Remarks.—*L. pectinata pacifica* can be distinguished from the typical form and from the variety described by Darwin (1851) and the variety *squamosa* Fischer (1884) and the subspecies *beringiana* Pilsbry (1911) by the single occludent margin of the tergum, the absence of umbonal teeth on the scuta, and the absence of caudal appendages. It can be distinguished from all except subspecies *beringiana* by the smoothness of the plates.

Localities.—Biorka Island, Alaska, July 21, 1936, on *L. fascicularis*. Queen Charlotte Sound, British Columbia, July 6, 1934, on *L. fascicularis*. Lousonne Harbor, Queen Charlotte Island, British Columbia, February 11, 1935, with *L. anatifera*. Harriet Harbor, Moresby Island, British Columbia, August 29, 1934, on kelp with *L. anatifera*. Naden Harbor, Graham Island, British Columbia, August 28, 1937, on kelp. Swiftsure Bank (lat. 48°31' N., long. 124°53' W.), July 10, 1935, on *Fucus*; August 5, 1934, on *L. fascicularis*. Friday Harbor, Wash., July 13, 1937, on floating limb; July 14, 1937, on floating board, with *L. anatifera*; July 26, 1937, on floating board. Willapa Harbor, 1922, on kelp. Manzanita Beach, Oreg., August 20, 1938, on driftwood, washed on shore. Short Sandy Beach, Oreg., August 20, 1938, on *Fucus*, washed on shore.

LEPAS FASCICULARIS AURIVILLII Nilsson-Cantell

FIGURE 4

Lepas fascicularis aurivillii NILSSON-CANTELL, 1921, p. 238.

Diagnosis.—Externally like the typical form. Cirri shorter, with broader segments, covered with fine hairs. Carina same width as in the typical form (Nilsson-Cantell).

Supplementary description.—Specimens of this subspecies were collected in three localities. Unlike the specimens described by Nilsson-Cantell, certain external characters varied somewhat from those of *L. fascicularis*.

As Nilsson-Cantell (1921) pointed out, there are five filamentary appendages, and the mouth parts do not differ from those of the typical form, as figured by Hoek (1883). All the maxillae examined had three steps below the upper large spines. Von Willemöes-Suhm (1876) examined a large series of *L. fascicularis* and found three steps more frequently than four steps as found by Darwin. He also found mandibles with four teeth instead of five. Many small spines occur on both edges of the teeth and to some extent on the surface.

The specimens examined differ from the typical form and are similar to Darwin's variety *villosa* in that the valves are not approximate. The interspace between the scutum and tergum is almost half the width of the scutum. The carina also differs from that of the typical form and is similar to that of the variety *donovani* Leach as described by Darwin. It is flat above the umbo and has a narrow central external ridge, which is somewhat less distinct on the disk (fig. 4).

The valves are covered with a spinose membrane, although the spines are more minute than those seen by Darwin. Hoek (1883) also found the smaller spines on *L. fascicularis* from the Pacific.

Size.—The largest specimen had a capitulum 47 mm. in length and 37 mm. in width; the peduncle was 10 mm. in length and 8 mm. in width. The largest specimen described by Nilsson-Cantell (1921) had a capitulum 8 mm. in length and 6 mm. in width.

Localities.—Bangkok, on *Limulus*; Java Sea (Nilsson-Cantell). New records: Queen Charlotte Sound, British Columbia, July 6, 1934, floating, a number of specimens attached to gelatinous balls. Biorka Island, Alaska, July 21, 1926, also attached to gelatinous balls. Swiftsure Bank (lat. 48°31' N., long. 124°53' W.), August 5, 1934, attached to a gelatinous ball.

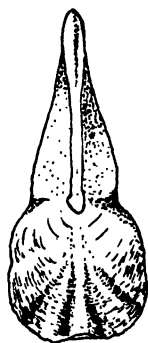


FIGURE 4.—*Lepas fascicularis aurivillii* from Biorka Island, Alaska: Carina, external view. Natural size.

Genus SCALPELLUM Leach

SCALPELLUM COLUMBIANUM Pilsbry

FIGURE 5

Scalpellum (Arcoscalpellum) columbianum PILSBRY, 1909, p. 367; CORNWALL, 1930, pp. 215-217.

This species was described by Pilsbry from three specimens from British Columbia. Cornwall (1930) described the mouth parts of two specimens also from British Columbia and pointed out several variations from the type material, i. e., the greater width of the inframedian latus, the presence of hair on the outer margin of the carina, and the slightly greater width of the capitulum. Cornwall also figures three small individuals found with the two adults.

Five adult specimens of this species, found off Allen Bank, Puget Sound, were unfortunately preserved dry. One adult and two immature forms were found off Point No Point, Puget Sound. The adults resembled those figured by Cornwall more nearly than the type material. In all, the inframedian latus is wider than that of the type and the capitulum is only 1.8 times as long as wide instead of more than twice as long as in the type.

Other plates show some variation in proportion. In most the rostral latus was more nearly the same width throughout instead of much wider near the inframedian latus. Also the upper latus was in most specimens wider in proportion to the length than in the type.

The capitulum is covered with a thin membrane on which fine spines occur. These are slightly longer and more numerous near the carina and are especially long along the ridges of the carina. In all the specimens the scales on the peduncle are more numerous, 25 to 30 in a row, instead of about 10 as in the type.

The younger of the two immature forms (fig. 5, *a*) was very similar to the immature form of *S. gruvelianum* figured by Broch (1922). All the plates except the rostral latus and rostrum were present. The surface was covered with a membrane with fine hairs and a pair of "tentacular appendages" covered with fine hairs occurred at the apex of the capitulum. At the base of the capitulum there were two large scales on each side and one smaller scale below the rostral angles of the scuta. In the older specimen the rostral latus was present, and a sixth scale occurred on the peduncle below the carina. In neither individual could the rostrum be distinguished.

The mouth parts of the specimen examined differed somewhat from Cornwall's description. The upper part of the labrum is bullate (fig. 5, *b*), and the palpi are somewhat acuminate. The fourth tooth of the mandible is less blunt, and a greater part of the surface is covered with hairs (fig. 5, *f*). The maxilla (fig. 5, *d*) shows no notch

below the upper large pair of spines. There are seven pairs of spines below the upper pair. The last three are on a slight prominence. The inferior border and the surface near the origin of the spines are covered with fine hairs. Highly prominent tubular olfactory organs are situated on the external surface of the outer maxillae.

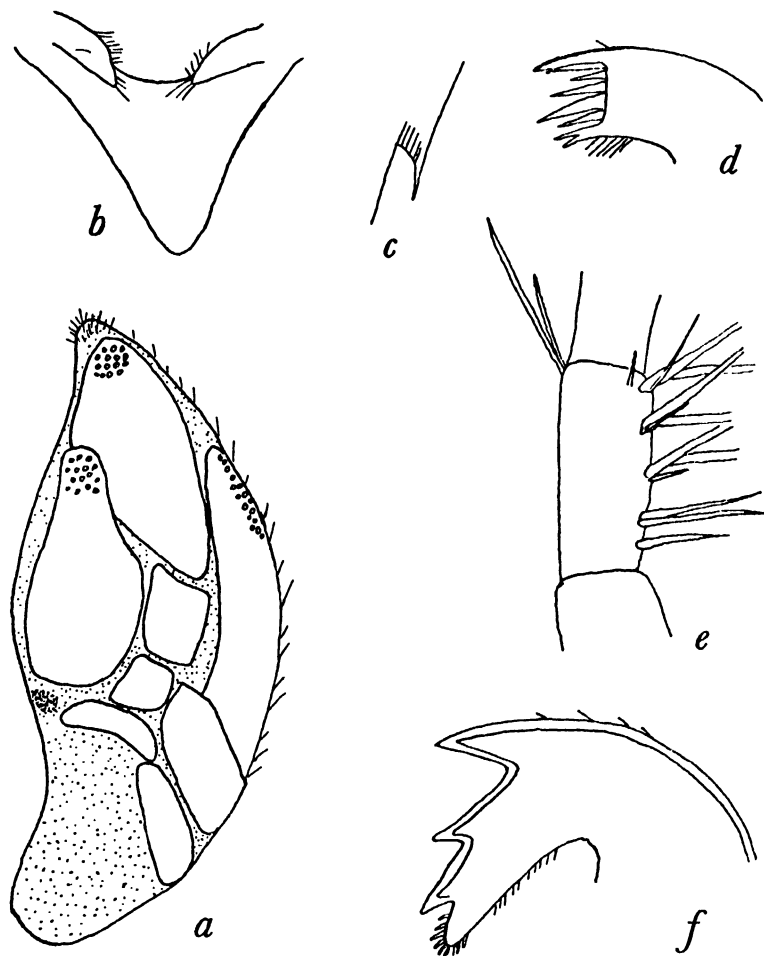


FIGURE 5.—*Scalpellum columbianum* from Point No Point, Puget Sound: *a*, Immature, side view, $\times 58$; *b*, labrum, $\times 30$; *c*, caudal appendage, $\times 30$; *d*, maxilla, $\times 80$; *e*, sixth segment of cirrus VI, $\times 80$; *f*, mandible, $\times 80$.

The anterior ramus of cirrus I is only slightly shorter than the posterior ramus; both rami have seven segments. The first cirrus is set a little apart from the other cirri. The second cirrus is longer than the first and a little shorter than the third. The rami of both the second and third cirri are unequal in length. The posterior cirri are slightly curled. The sixth cirrus (fig. 5, *e*) has four pairs of

spines on the median segments of the outer ramus and five pairs on the median segments of the inner. There are two long thin spines on the posterior distal angle and usually one very fine short spine on the anterior distal border.

The caudal appendages (fig. 5, *c*) are short and flat with truncated ends bearing fine spines. There is no penis.

Size (in millimeters) as follows:

CAPITULUM:

| | | | | | | |
|--------------|----|----|-----|---|-----|----|
| Length ----- | 10 | 10 | 9 | 9 | 8.5 | 11 |
| Width ----- | 5 | 5 | 4.5 | 4 | 4 | 7 |

PEDUNCLE:

| | | | | | | |
|--------------|---|---|---|---|---|-----|
| Length ----- | 3 | 3 | 3 | 2 | 2 | 4.5 |
| Width ----- | 2 | 2 | 2 | 2 | 2 | 3 |

Localities.—Off Allen Bank, Puget Sound, April 8, 1937, 60 meters; one specimen on *Boltenia villosa*, four specimens on *Pyura haustor*., Off Point No Point, Puget Sound, April 7, 1933, 90 meters, one adult and two immature on coral.

Genus MITELLA Oken

MITELLA POLYMERUS (Sowerby)

Synonymy: See Nilsson-Cantell, 1921, p. 165.

This species is abundant in many localities in Puget Sound and individuals often attain a large size. The scales on the median part of the peduncle are intermediate in size between those figured for forma *typica* and forma *echinata* by Broch (1922). Gruvel (1905) and Nilsson-Cantell (1921) state that the scales on the lower part of the peduncle are in the form of spines and somewhat irregularly arranged. An examination of a number of specimens failed to reveal any "spines" on the peduncle, which is in accord with the findings of Broch (1922).

The mouth parts and cirri agree with the description of Darwin. The membrane covering the prosoma and the sack, as well as the mouth parts and some of the segments of the cirri, is covered with fine spines. The spines are slightly larger and more numerous on the membrane just below the labrum. The papillae on each side of the filamentary appendages and on the sack have short spines and spinules similar to those found on the filamentary appendages.

In many of the large specimens the caudal appendages have two segments, with short spines at the upper edge of each. In two specimens only one caudal appendage occurred.

Localities.—Washington: False Bay, San Juan Island; Iceberg Point, Lopez Island; Goose Island; Seal Rock and Waadah Island, Neah Bay. Bandon, Oreg. Trinidad, Calif. Ensenada, Lower California.

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REVISION OF THE CHALCID-FLIES OF THE TRIBE CHALCIDINI IN AMERICA NORTH OF MEXICO

By B. D. BURKS

THE tribe Chalcidini includes a relatively large number of the more conspicuous Nearctic chalcidoids, most of which have long been included in the genus *Smicra*. All the species in this tribe are referable to the section "Abdomine Petiolato" of the genus *Chalcis*¹ of Fabricius. The tribe Chalcidini as here limited is equivalent to the genus *Chalcis* as defined by Westwood.² Most authors have treated the group as the genus *Smicra* or *Smiera*. As Gahan and Fagan³ showed that *Smicra* (*Smiera*) Spinola and *Chalcis* Fabricius were isogenotypic, the genus formerly called *Smicra* took the name *Chalcis* instead, and the species that had long been placed in the latter genus were referred to *Brachymeria*. In 1904 Ashmead⁴ formulated the tribe Smicrini and included in it, along with *Smicra*, a large number of genera. With the change in the name of its type genus, it becomes necessary likewise to change the name of the tribe Smicrini to Chalcidini, the Chalcidini of Ashmead becoming Brachymerini. The tribe Chalcidini, as treated here, is almost identical with Smicrini Ashmead.

METHODS

In this paper, wherever possible, the comparative terms in general use in insect morphology have been used instead of the more or less conventional taxonomic terminology.

¹ *Systema plezatorum*, p. 150, 1804.

² An introduction to the modern classification of insects, vol. 2, p. 65, 1840.

³ U. S. Nat. Mus. Bull. 124, p. 133, 1923.

⁴ Mem. Carnegie Mus., vol. 1, p. 250, 1904.

The structures mentioned in the following keys and descriptions may be located by referring to figures 6, 7, *a*, 10, *b*, and 13, *b*. Figure 6 shows those structures visible from the lateral aspect of the entire body, figure 7, *a*, the structures and areas visible from the anterior aspect of the head, and figure 10, *b*, the sclerites and areas of the dorsum of the thorax. Figure 13, *b*, is the posterior aspect of a propodeum and shows the location of the spiracles on that segment. These spiracles are somewhat difficult to locate on many specimens.

In order to see the characters used in the keys and descriptions in this paper, it is necessary to use a microscope providing magnifications of 50 to 100 diameters and a very strong light. All measurements used have been made with a disk micrometer. Definite measurements in millimeters are not usable in the Chalcidini, because of the wide range in size of specimens to be encountered within a species. Comparative measurements of two structures on the same specimen are, however, fairly reliable. Several hundred measurements made on specimens of two of the commonest species, *Spilochalcis mariae* (Riley) and *S. side* (Walker), indicate that variations of 10 to 15 percent in these comparative measurements are to be expected. The measurements given in the following descriptions are, therefore, stated in terms that seem broad enough to encompass the actual or probable variation. In the descriptions the term "slightly" is used where structures are visibly not the same size, but measurements have shown them to differ by less than 10 percent.

FIGURE 6.—*Chalcis sispes* (Linnaeus): Lateral aspect.

| | | | |
|--------------------|--------------------|-----------------------------|--|
| <i>As</i> ----- | axilla | <i>MtW</i> ----- | hindwing |
| <i>C</i> ----- | costal vein | <i>Mv</i> ----- | marginal vein |
| <i>CE</i> ----- | compound eye | <i>Mw</i> ----- | forewing |
| <i>Cer</i> ----- | cercus | <i>Oc</i> ----- | ocellus |
| <i>Cl</i> ----- | clypeus | <i>P</i> ----- | pedicel |
| <i>Cu</i> ----- | cubital vein | <i>Pa</i> ----- | parapsidal furrow |
| <i>Ep</i> ----- | epipygium | <i>PMv</i> ----- | postmarginal vein |
| <i>FGS</i> ----- | frontogenal suture | <i>Pn</i> ----- | pronotum |
| <i>Fl</i> ----- | flagellum | <i>Pr</i> ----- | propodeum |
| <i>Hy</i> ----- | hypopygium | <i>PrP</i> ----- | prepectus |
| <i>M</i> ----- | medial vein | <i>Pt</i> ----- | petiole |
| <i>MO</i> ----- | mesocoxa | <i>r-m</i> ----- | radio-medial cross vein |
| <i>Md</i> ----- | mandible | <i>RS</i> ----- | ring segment |
| <i>MEp</i> ----- | mesoepimeron | <i>Rs</i> ----- | radial sector vein |
| <i>MEps</i> ----- | mesoepisternum | <i>Rs₁</i> ----- | anterior branch of radial sector vein |
| <i>MF</i> ----- | mesofemur | <i>Sc</i> ----- | subcostal vein |
| <i>MPs</i> ----- | mesopraescutum | <i>Sca</i> ----- | antennal scape |
| <i>Ms</i> ----- | mesoscutum | <i>Sh</i> ----- | ovipositor sheath |
| <i>MSo</i> ----- | mesoscutellum | <i>SMv</i> ----- | submarginal vein |
| <i>MtC</i> ----- | metacoxa | <i>Sp</i> ----- | tibial spur |
| <i>MtEps</i> ----- | metepisternum | <i>St</i> ----- | stigmal vein |
| <i>MtF</i> ----- | metafemur | <i>Str</i> ----- | strigilis |
| <i>MtN</i> ----- | metanotum | <i>Tg</i> ----- | tegula |
| <i>MtT</i> ----- | metatrochanter | | |
| <i>MtTt</i> ----- | metatibia | | |



FIGURE 6.—See p. 238 for explanation.

The measurements of the width of the malar space, the interocular space, and the height of the compound eyes have been uniformly made from the anterior aspect. It is obviously necessary to measure all specimens from the same angle, as none of the areas to be measured is flat; the width of the compound eye varies widely if specimens are not all measured from exactly the same angle. The lengths of the various segments of the antennae have been measured from the dorsal aspect; measurements made from any other angle will not agree with those given here. The length and width of the petiole have, likewise, been measured from the dorsal aspect.

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Superfamily CHALCIDOIDEA

Family CHALCIDIDAE

Subfamily CHALCIDINAE

Tribe CHALCIDINI

Chalcis FABRICIUS, Mantissa insectorum . . . , vol. 1, p. 272, 1787 (in part).

Smicrini ASHMEAD, Mem. Carnegie Mus., vol. 1, p. 248, 1904.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 18, 1909.—HANDLIRSCH, in Schröder's Handbuch der Entomologie, vol. 3, p. 771, 1925; in Kükenthal's Handbuch der Zoologie, vol. 4, p. 976, 1933.

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The following characters will differentiate the members of the tribe Chalcidini from all other members of the superfamily Chalcidoidea:

Antennae 13-segmented, inserted approximately in center of frons, usually considerably dorsad of ventral margins of compound eyes, but occasionally at level of ventral margins (fig. 7, *a*, *e*, *f*), never inserted near clypeal suture (as in fig. 7, *d*); vertex not produced anteriorly in form of two hornlike projections (as in fig. 7, *b*, *c*); tegulae not extended anteriorly to, or almost to, posterior margins of

pronotum, as in *Leucospis* (fig. 10, *a*); forewings always with a distinct cell indicated posterior to marginal vein (fig. 6), never with an isolated fragment of base of M+Cu₁ preserved in wing, as in *Leucospis* (fig. 10, *g*); hindwing always with three hamuli (except in some species of the *nigricornis* group of *Spilochalcis*); metacoxae enlarged, long, round in cross section; metafemora enlarged, provided with more than one tooth on outer ventral margin (figs. 11, *h-k*; 12); metatibiae completely arcuate and provided with only one apical spur (fig. 11, *h*), never incompletely arcuate and provided with two apical spurs, as in *Haltichella* (fig. 11, *g*); propodeum provided with a pair of slitlike spiracles (fig. 13, *b*); abdomen distinctly petiolate, petiole always with a basal lamina (fig. 13, *d-j*), never sessile; petiole arising from apex of propodeum, never far up near apex of mesoscutellum; cerci reduced to a pair of disk-shaped setigerous sclerites, which are placed well in from posterior margin of epipygium (fig. 13, *f-j*), never distinctly produced and articulated at base, as in *Podagrion* (fig. 14, *h*); male genitalia (fig. 14, *o*) composed of an outer membranous sheath, a sclerotized inner sheath (*Sh*), a pair of toothed sagittae (*Sag*), and a pair of apically fused penis valves (*Oe*).

KEY TO GENERA OF CHALCIDINI

1. Female, ninth sternite concealed, antennal scape narrow.....2
 Male, ninth sternite exposed, antennal scape broad.....6
2. Hypopygium produced posteriorly to or beyond apex of abdomen,
 ovipositor arising near apex (fig. 13, *f, g, j*).....3
 Hypopygium absent or very indistinct, ovipositor arising far
 forward (fig. 13, *d, h, i*).....4
3. Metafemora with three or four large, slightly curved teeth (fig.
 11, *k*); anterior dorsal margin of pronotum with a lamina
 extending completely across.....Metadontia
 All metafemoral teeth, except basal one, small, none curved
 (fig. 11, *i, j*); anterior dorsal margin of pronotum acarinate
 mesally.....Chalcis
4. Abdominal petiole long, slender, three-fourths or more length
 of metacoxa.....5
 Petiole short, usually stout, always only one-half or less length
 of metacoxa.....Spilochalcis
5. Parapsidal furrows distinct, apex of mesoscutellum without pro-
 jections.....Ceratosmicra
 Parapsidal furrows obliterated, apex of mesoscutellum with two
 prominent, upturned projections.....Xanthomelanus
6. Claws of protarsi bifid at apices (fig. 11, *a-f*), ninth sternite of
 abdomen emarginate at apex (fig. 14, *a-g*).....Chalcis
 Claws of protarsi simple, ninth sternite entire or very obscurely
 emarginate.....7
7. Petiole long and slender, always more than four-fifths length of
 metacoxa.....8
 Petiole always less than two-thirds length of metacoxa.....9

8. Parapsidal furrows distinct, apex of mesoscutellum without projections----- *Ceratosmicra*
 Parapsidal furrows obliterated, apex of mesoscutellum with two prominent, upturned projections----- *Xanthomelanus*
9. Procoxae, from lateral aspect, longer than wide, metafemora with five or six long, slightly curved teeth (fig. 11, *k*)----- *Metadontia*
 Procoxae, from lateral aspect, as long as wide or wider than long, metafemora usually with no long, curved teeth, sometimes with three (fig. 12, *a-k*)----- *Spilochalcis*

The genus *Xanthomelanus* has not, so far, been found to have any representatives in America north of Mexico, but it is quite likely that some will eventually be found here. The genus has, therefore been included. This generic key will probably not serve for the segregation of Neotropical material, as I have made no intensive effort to discover generic characters in the available extralimital material.

Genus CHALCIS Fabricius

Chalcis FABRICIUS, Mantissa insectorum . . . , vol. 1, p. 272, 1787 (in part).—

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Mexico, p. 67, 1887.—ASHMEAD, Ent. Amer., vol. 4, p. 87, 1888.—DALLA TORRE, Catalogus hymenopterorum . . . , vol. 5, p. 372, 1898.—ASHMEAD, Mem. Carnegie Mus., vol. 1, p. 250, 1904.—KIEFFER, Berliner Ent. Zeitschr., vol. 49, p. 245, 1905.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 30, 1909.—VIERECK, Connecticut Geol. and Nat. Hist. Surv. Bull. 22, p. 528, 1916.

Description.—Legs and venter of body densely covered with short, hydrofuge pubescence, dorsum with longer, more scattered pubescence; punctuation coarse; antennae 13-segmented, inserted approximately in center of frons; female flagellum slightly enlarged toward apex, male flagellum uniform in size throughout, fourth antennal segment always longer than any following segments; eyes relatively small, width of malar space usually one-half or more height of compound eye; head transverse when viewed from dorsal aspect; right mandible always with three teeth, left with two or three teeth, dorsal one always largest and longest; protarsal claws of male bifid at apex and provided with several large spines on basal enlargement, claws of female elongate, simple at apex, but usually with teeth or spines at base; prepectus often completely concealed, when visible, discernible as a narrow, tonguelike sclerite projecting between lateral margin of mesoscutum and mesopleuron; metacoxae long, slender, without a smooth asetose area on dorsal surface; forewing with cell R_1 narrow (fig. 6); gaster of abdomen globose, third abdominal segment usually occupying almost half length of gaster; ovipositor normally held nearly upright, arising near posterior end of abdomen; female with hypopygium conspicuously exerted (fig. 13, *f*, *g*); ninth sternite of male slightly excavated in mesal area and emarginate at apex (fig. 14, *a-g*).

Remarks.—The species of *Chalcis* are, where known, parasites of the larvae of Stratiomyiidae and are to be taken only in cattail bogs and other such marshy habitats. *Chalcis* is typically northern in distribution, but a few specimens referable to this genus have been collected from mountainous localities in the subtropical and tropical areas.

Henneguy⁶ describes and figures the egg and three stages in the embryological development of the European species *Chalcis sispes* (Linnaeus). The egg of this species differs from that of most chalcids in having a stalk at each end, rather than only at one end. Bischoff⁶ states that the eggs of *Chalcis* are deposited in the egg masses of their stratiomyiid hosts. Hart⁷ has published some observations on the habits of some species of *Chalcis* in America. He observed the adults apparently feeding on stratiomyiid eggs and reared two species from their larvae.

⁶ Les insectes, pp. 314, 337, 1904.

⁶ Biologie der Hymenopteren, p. 423, 1927.

⁷ Illinois State Lab. Nat. Hist. Bull. 4, p. 258, 1894.

KEY TO SPECIES OF CHALCIS

1. Female, hypopygium exerted (fig. 13, *f*, *g*), antennal scape slender..... 2
 Male, ninth sternite emarginate (fig. 14, *a-g*), antennal scape broadened..... 10
2. Metafemur with outer basal tooth much larger and longer than following teeth (fig. 11, *j*)..... 3
 Metafemur with outer basal tooth little if any larger than following teeth (fig. 11, *i*)..... 5
3. Dorsum of thorax entirely black..... megalomis (p. 250)
 Dorsum of thorax with yellow markings..... 4
4. Dorsum of pronotum with a yellow band extending completely across posterior margin; body sparsely setose..... divisa (p. 246)
 Dorsum of pronotum with two yellow spots near lateral margins; body densely covered with long, white setae..... lasia (p. 248)
5. Apex of hypopygium isolated from eighth tergite (fig. 13, *g*)..... 6
 Apex of hypopygium not isolated from eighth tergite (fig. 13, *f*)..... 8
6. Inner tooth of metafemur lacking..... flebilis (p. 254)
 Inner tooth of metafemur present, large, acute..... 7
7. Petiole conspicuously rugose over entire surface; outer surface of metafemur brown or black with yellow or tan markings..... neptis (p. 251)
 Petiole reticulated only near base; outer surface of metafemur uniformly brown..... barbara (p. 255)
8. Dorsal surface of petiole densely covered by short, irregular carinae..... canadensis (p. 258)
 Dorsal surface of petiole glabrous, or nearly so; carinae, if present, located only laterad on petiole..... 9
9. Petiole with lateral carinae; mesotibia with strong apical spur..... microgaster (p. 259)
 Petiole without lateral carinae; mesotibial spur extremely minute..... phoenicapoda (p. 257)
10. Petiole yellow..... 11
 Petiole brown or black..... 12
11. Setae of body short; posterior carina of head extended dorsad only one-half distance from base of mandible to dorsal angle of head (fig. 7, *h*)..... divisa (p. 246)
 Body densely covered with conspicuous, long, white setae; posterior carina of head extended to dorsal angle of head (fig. 7, *i*)..... lasia (p. 248)
12. Petiole conspicuously rugose, ventral surface with a strong longitudinal, mesal carina..... neptis (p. 251)
 Petiole without a mesal carina on ventral surface..... 13
13. Inner tooth of metafemur large, acute; frontogenal suture strongly angled..... barbara (p. 255)
 Inner tooth of metafemur minute and obscure or lacking entirely; frontogenal suture straight or lacking..... 14
14. Antennal scape spatulate (fig. 8, *d*)..... flebilis (p. 254)
 Antennal scape not spatulate..... 15
15. Antennal scape expanded near base (fig. 8, *f*)..... canadensis (p. 258)
 Antennal scape nearly uniform in width throughout (fig. 8, *g*)..... microgaster (p. 259)

CHALCIS DIVISA (Walker)

FIGURES 7, *h*; 8, *a*; 14, *a**Smicra divisa* WALKER, Journ. Ent., vol. 1, p. 178, 1861.*Smicra divisa* (Walker) WALKER, Notes on Chalcidae, p. 51, 1871.—CRESSON, Trans. Amer. Ent. Soc., vol. 4, p. 55, 1872.—CAMERON, Biologia Centrali-Americana, Hymenoptera, vol. 1, p. 96, 1884.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 34, 1885.—DALLA TORRE, Catalogus hymenopterorum . . . , vol. 5, p. 376, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 34, 1909.

This species is most readily recognized in the female by the transverse yellow stripe at the posterior margin of the dorsum of the pronotum and by the large basal tooth of the metafemur; the male is recognized by its long, slender, yellow petiole and the wide malar space.

Description.—Black with yellow markings; frons, except small area dorsad of clypeus, posterior dorsal margin of pronotum, tegulae, usually apices of profemora and mesofemora, posterolateral angles of mesoscutellum, base and angled dorsal and apical stripe of metafemora, basal half of metatibia, and petiole, yellow; most of anterior and mesolegs, apices of metacoxae, disk and apex of metafemora, and gaster, reddish brown.

Female: 7–8 mm. Antennae inserted ventrad of center of frons, scape exceeding level of posterior ocelli by one-quarter its length, pedicel one-third and ring segment one-sixth length of segment 4, segment 13 minute; margin of scrobe cavity acarinate laterad, strong transverse carinae present in scrobe cavity just ventral to anterior ocellus; interantennal projection with a distinct mesal carina; width of malar space three-fifths height of compound eye; frontogenal suture obsolete; combined widths of compound eyes two-thirds interocular space at level of antennal bases; posterior carina of head extending from base of mandible to middle of posterior margin of compound eye (fig. 7, *h*); head, viewed from dorsal aspect, strongly transverse with compound eyes protruding.

FIGURE 7.—Heads of Chalcidini.

- a*, *Spilochalcis xanthostigma* (Dalman): Anterior aspect. (*AT*, anterior tentorial pit; *CE*, compound eye; *Cl*, clypeus; *FGS*, frontogenal suture; *FP*, frontal tentorial pit; *IP*, interantennal projection; *MS*, malar space; *Oc*, ocellus; *SC*, scrobe cavity; *W*, interocellar space; *X*, width of compound eye; *Y*, height of compound eye; *Z*, interocular space.)
- b*, *c*, *Dirhinus texanus* (Ashmead): *b*, Dorsal aspect; *c*, lateral aspect.
- d*, *Haltichella* sp.: Anterior aspect.
- e*, *Spilochalcis flavopicta* (Cresson): Anterior aspect.
- f*, *j*, *Spilochalcis femorata* (Fabricius): *f*, Anterior aspect; *j*, lateral aspect.
- g*, *Spilochalcis juxta* (Cresson): Lateral aspect.
- h*, *Chalcis divisa* (Walker): Lateral aspect.
- i*, *Chalcis lasia*, new species: Lateral aspect.

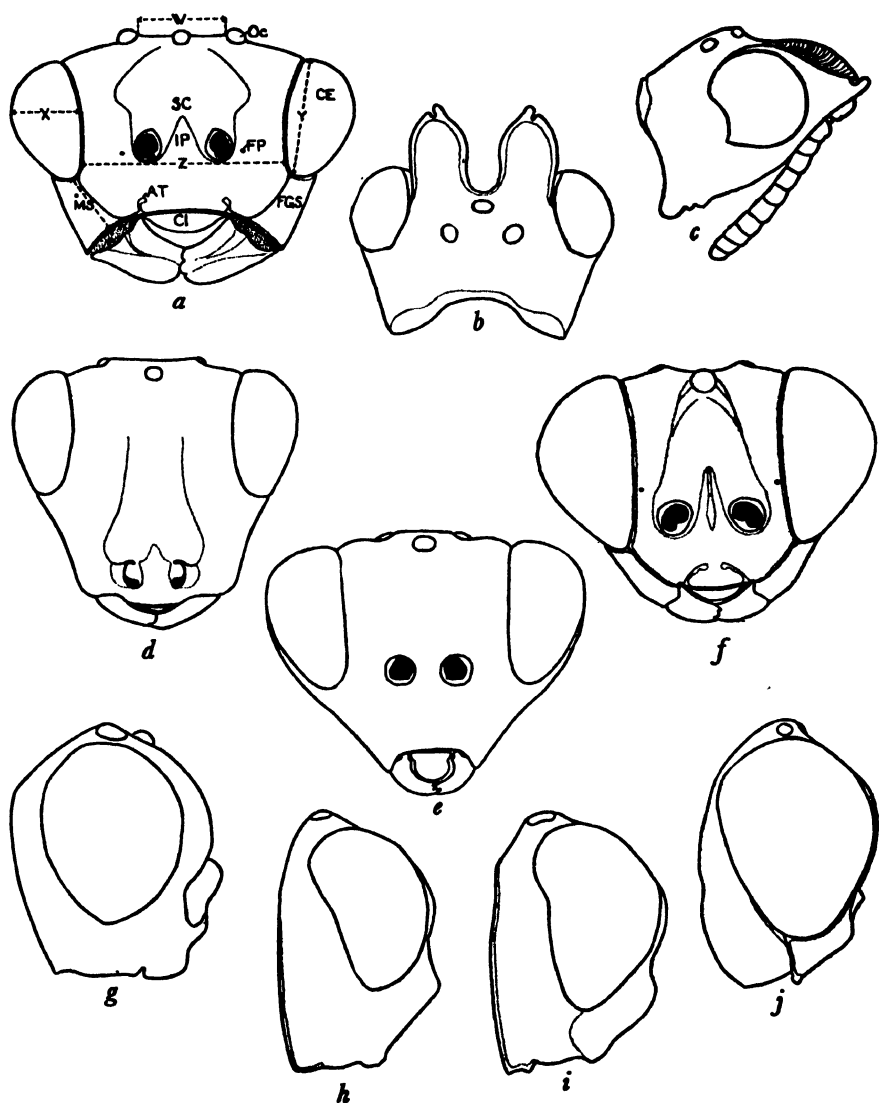


FIGURE 7.—See opposite page for explanation.

Anterolateral and sublateral angles of pronotum slightly produced, vaguely carinate; pubescence fine, inconspicuous, all setae of uniform length; prepectus extremely narrow, sometimes entirely concealed; apex of mesoscutellum provided with a narrow, mesally depressed lamina; outer basal tooth of metafemur large (as in fig. 11, *j*), followed by six to eight smaller teeth, apical two or three indistinctly divided; inner tooth absent; apex of metatibia very slender and acute, long, almost reaching trochanter when tibia is folded against femur.

Propodeum coarsely and irregularly carinate, large, lateral teeth projecting on each side of point of insertion of petiole, spiracular openings vertical; petiole glabrous, twice as long as wide, a pair of minute lateral, subbasal projections usually present; gaster usually equal in length to metafemur, abdominal segments 4 to 7 densely covered with lateral setae; eighth tergite densely setose; cerci round, located near posterior margin of epipygium; apex of ovipositor sheath provided with a few long, ventral setae; apex of hypopygium isolated from eighth tergite (as in fig. 13, *g*).

Male: 6.5 mm. Antennal scape broadened from base to apex (fig. 8, *a*); outer basal tooth of metafemur no longer than following ones; petiole three times as long as wide; gaster slightly shorter than metafemur; ninth sternite shallowly excavated on meson (fig. 14, *a*).

Type locality.—Mexico.

Types.—Lectotype, male, British Museum; lectoallotype, female, British Museum; comparisons made by Dr. Ch. Ferrière. The abdomen and hindlegs are missing from the female type.

Host.—Unknown.

Distribution.—ARIZONA: Grand Canyon, July 10, 1892, 1 female; July 27, 1 male. KANSAS: McPherson County, July 1, 1934, C. W. Sabrosky, 1 female. OKLAHOMA: Reagan, June 2, 1937, H. H. Ross, 5 females, 3 males. OREGON: Breitenbush Hot Springs, July 2, 1934, H. A. Scullen, 1 male. MEXICO: Matamoros, August 12, 1903, W. L. Tower, 1 female.

CHALCIS LASIA, new species

FIGURES 7, *i*; 8, *b*; 11, *a*; 14, *b*, *c*

This species is closely allied to *Chalcis divisa* (Walker) but is most readily distinguished by these characters: Body elongate, narrow, conspicuously covered with long, white setae of various lengths, posterior carina of head extended from base of mandible to posterodorsal angle of head, apical lamina of mesoscutellum not depressed on meson.

Description.—Black with yellow markings, setae white; frons laterad of scrobe cavity, anterior and mesolegs, lateral triangular spots on dorsum of pronotum, two lateral spots on mesoscutellum, in fe-

male two small areas at posterolateral angles of mesopraescutum, wide basal, dorsal, and subapical areas on outer surface of metafemur, basal and ventral stripe on metatibia, petiole, and transverse dorsal spot on male third abdominal segment, yellow; disk and apex of outer surface of metafemur brown or black.

Female: 8 mm. Antennae inserted ventrad of center of frons, scape exceeding level of posterior ocelli, pedicel one-third, ring segment one-tenth length of segment 4, flagellar segments somewhat variable and asymmetrical, segment 5 usually two-thirds length of 4, last three segments indistinctly divided; scrobe cavity deep, surface provided with strong transverse carinae; interantennal projection with a small, irregular anterior carina; frons densely covered with long, white pubescence; surface provided with irregular punctures and minute carinae; width of malar space one-half height of compound eye, frontogenal suture obsolete; combined widths of compound eyes three-quarters width of interocular space at level of antennal bases; left mandible with two blunt teeth, dorsal one much larger, right mandible with three teeth, dorsal one acute, two ventral ones blunt.

Dorsum of thorax deeply and densely punctured, punctures somewhat shallower on mesoscutum, pubescence very long and dense; anterolateral angles of pronotum carinate, anterior dorsal margin acarinate on mesal two-thirds; parapsidal grooves obscure; apical spur of mesotibia small; apex of mesoscutellum with a narrow lamina, which is not depressed on meson; metafemur densely covered by minute setae, outer ventral margin with 11 to 14 small, widely spaced teeth, basal tooth larger than others; inner tooth minute, located near trochanter; apex of mesotibia acute, variable in length.

Propodeum covered with strong, irregular carinae; two basolateral areas minutely reticulated, almost smooth; spiracular openings slightly oblique; no lateral propodeal teeth present; petiole glabrous, two and one-half times as long as wide, lateral carinae present on basal one-third of petiole; gaster slightly shorter than metafemur; abdominal segments 3 to 7 with long lateral setae; eighth tergite obscurely punctured and lightly shagreened; cerci oval, located near anterior margin of ninth tergite; apex of hypopygium isolated from eighth tergite.

Male: 7 mm. Antennal scape expanded (fig. 8, *b*); frontogenal suture extending parallel with dorsal margin of clypeus for two-thirds its length, then sharply curved toward compound eye (fig. 7, *i*); combined widths of compound eyes equal to interocular space at level of antennal bases; protarsal claw (fig. 11, *a*) with many long, comblike teeth; basal tooth of metafemur not larger than others; petiole three and one-half times as long as wide; ninth sternite (fig. 14, *b*) slightly excavated on meson.

Type locality.—California.

Types.—Holotype, female, Mojave, Calif., April 26, 1936, E. G. Linsley; allotype, male, Tehachapi, Calif., August 3, 1897, C. F. Baker; paratypes, California, 2 males, southern California, 1 male. Holotype and allotype deposited in the U. S. National Museum, paratypes in the Academy of Natural Sciences of Philadelphia.

Host.—Unknown.

CHALCIS MEGALOMIS, new species

FIGURE 11, *f*

This species is closely related to *Chalcis divisa* (Walker) but is most readily distinguished by the wider malar space, shorter petiole, and the completely black dorsum of the thorax.

Description.—Black; two small spots on frons near bases of antennae, base of metafemur, and petiole, yellow; protibiae and mesotibiae and all tarsi, wings, and gaster, brown.

Female: 5–8 mm. Antennae inserted slightly ventrad of center of frons, scape exceeding, by one-fourth its length, level of posterior ocelli, ring segment less than one-half length of pedicel, segment 4 one-eighth longer than 5, segments 5 to 7 equal, following ones shorter, except 13, which equals length of 7; a series of parallel transverse ridges present in scrobe cavity just ventral to anterior ocellus; a prominent transverse carina present on frons just ventrad of antennal bases; malar space two-thirds height of compound eye; frontogenal suture obliterated; left mandible with one large acute dorsal tooth and one blunt ventral tooth, right mandible with three nearly equal rounded teeth; diameter of posterior ocellus slightly less than one-half width of interocellar space.

Dorsum of thorax covered by fine, decumbent pubescence, setae dense at posterolateral angles of pronotum; punctation coarse, deep; parapsidal grooves distinct; prepectus narrow, extending almost to tegula; mesotibial spur small; apex of mesoscutellum provided with a narrow, mesally emarginate lamina; metacoxae very slightly flattened on outer dorsal side at apex, pubescence dense, short; metafemur densely covered by short pubescence, ventral margin with 10 or 11 teeth, outer basal one three times as large as any others (fig. 11, *f*); inner tooth lacking; apex of metatibia long, sharp; apex of last segment of posterior tarsus with two long dorsal and two shorter lateral setae; claw long, with a very small, blunt inner tooth, basal enlargement without teeth or spines, but with several long setae.

Propodeum conspicuously carinate over entire surface; spiracular openings vertical; petiole glabrous, two-thirds length of metacoxa, a pair of small lateral projections present on each side near base; gaster usually slightly shorter than metafemur; third abdominal

segment with a few dorsal setae, following segments uniformly covered by moderately long setae; cerci oval, located near posterior margin of epipygium; ovipositor sheath with ventral margin straight, apex acutely pointed, a few long apical setae present on ventral side; hypopygium provided with a few long, lateral setae, apex isolated from eighth tergite (as in fig. 13, *g*).

Male: Unknown.

Type locality.—Northern Illinois.

Types.—Holotype, female, Princeton, Ill., July 2, 1936, Burks et al.; paratypes, Princeton, Ill., July 2, 1936, 12 females; Princeton, Ill., July 7, 1934, DeLong and Ross, 1 female; McHenry, Ill., July 27, 1934, DeLong and Ross, 2 females; Boulder, Colo., University Campus, October 2, 1917, Ada Knoale, 1 female. Holotype and 14 paratypes deposited in Illinois State Natural History Survey collection; three paratypes, U. S. National Museum; one paratype, British Museum.

Host.—Unknown.

CHALCIS NEPTIS, new species

FIGURES 8, *c*; 11, *b*; 14, *c*

This species is closely related to *Chalcis divisa* (Walker) but is distinguished by the long, narrow body, the longitudinal mesal depression of the mesopraescutum, and the conspicuously rugose petiole.

Description.—Black; two yellow spots on frons near bases of antennae; anterior and mesolegs brown, with apices of femora and tibiae yellow; wings brown; metafemora brown, usually with base, an oblique dorsal stripe, and a small ventral spot near apex, yellow.

Female: 5–6 mm. Antennae inserted slightly ventrad of center of frons; apex of scape just attaining level of posterior ocelli, ring segment one-half length of pedicel; segment 4 one and one-half times the length of segment 5, segments 5 and 6 equal, following ones slightly shorter and equal in length, suture between 12 and 13 obscure; interantennal projection large, terminating in a carina running halfway up scrobe cavity; width of malar space one-half height of compound eye; frontogenal suture extending ventrally from compound eye for two-thirds its length, then abruptly recurved toward mandible; a carina extends parallel to suture near mandible, then curves obliquely ventrally at point where suture curves: suture and carina enclose a small triangular area at ventral margin of compound eye; left mandible with one large, blunt, dorsal tooth and a smaller, rounded, ventral tooth, right mandible with one sharp dorsal tooth and two blunt ventral ones, ventral teeth slightly curved inward; diameter of posterior ocellus one-third width of interocellar space.

Pronotum with prominent laterodorsal tufts of pubescence; punctuation of dorsum of thorax coarse, irregular; parapsidal grooves partly obscured posteriorly; mesopraescutum with longitudinal mesal depression; prepectus visible only as a small triangular sclerite at anterolateral angle of mesoscutum; mesoscutellum slightly emarginate at apex; mesotibial spur minute; metacoxae slender, sparsely covered by long pubescence; outer surface of metafemur densely covered by short pubescence, scattered longer setae present at base and on ventral margin, 14 to 16 teeth present on outer ventral margin, basal one slightly larger; distinct, sharp inner tooth present; apex of metatibia long, sharp; six large apical spines present on posterior tarsus; claw long, basal enlargement with several minute spines.

Propodeum conspicuously carinate, laterobasal areas with carinae directed obliquely from meson, two strong, lateral, subapical carinae present, spiracular opening vertical; petiole twice as long as wide, surface conspicuously covered with irregular dorsal carinae and rugae, two strong lateral carinae present on either side, ventral one becoming obsolete before reaching apex, a row of long, dense setae present at each lateral margin; gaster usually equal in length to metafemur, third abdominal segment glabrous, without setae, following segments covered by short, appressed pubescence; cerci oval, located near anterior margin of epipygium; ovipositor sheath sinuate on ventral margin, apex acutely pointed and provided with a dense tuft of setae, some of which are long and slightly curved; hypopygium strongly exserted, apex isolated from eighth tergite (as in fig. 13, *g*).

FIGURE 8.—Male antennal scapes of Chalcidini.

- a*, *Chalcis divisa* (Walker): Mesal aspect.
- b*, *Chalcis lasia*, new species: Mesal aspect.
- c*, *Chalcis neptis*, new species: Mesal aspect.
- d*, *Chalcis flebilis* (Cresson): Mesal aspect.
- e*, *Chalcis barbara* (Cresson): Mesal aspect.
- f*, *Chalcis canadensis* (Cresson): Mesal aspect.
- g*, *Chalcis microgaster* Say: Mesal aspect.
- h*, *Spilochalcis exornata* (Cresson): Mesal aspect.
- i*, *Spilochalcis eubule* (Cresson): Mesal aspect.
- j*, *Spilochalcis dorsata* (Cresson): Mesal aspect.
- k*, *Spilochalcis transitiva* (Walker): Mesal aspect.
- l*, *m*, *Spilochalcis phoenicea*, new species: *l*, Mesal aspect; *m*, anterior aspect.
- n*, *Spilochalcis nigricornis* (Fabricius): Mesal aspect.
- o*, *Spilochalcis nortoni* (Cresson): Mesal aspect.
- p*, *Spilochalcis delicata* (Cresson): Mesal aspect.
- q*, *Spilochalcis hirtifemora* (Ashmead): Mesal aspect.
- r*, *Spilochalcis femorata* (Fabricius): Mesal aspect.
- s*, *Spilochalcis igneoides* (Kirby): Mesal aspect.
- t*, *Spilochalcis mariae* (Riley): Mesal aspect.

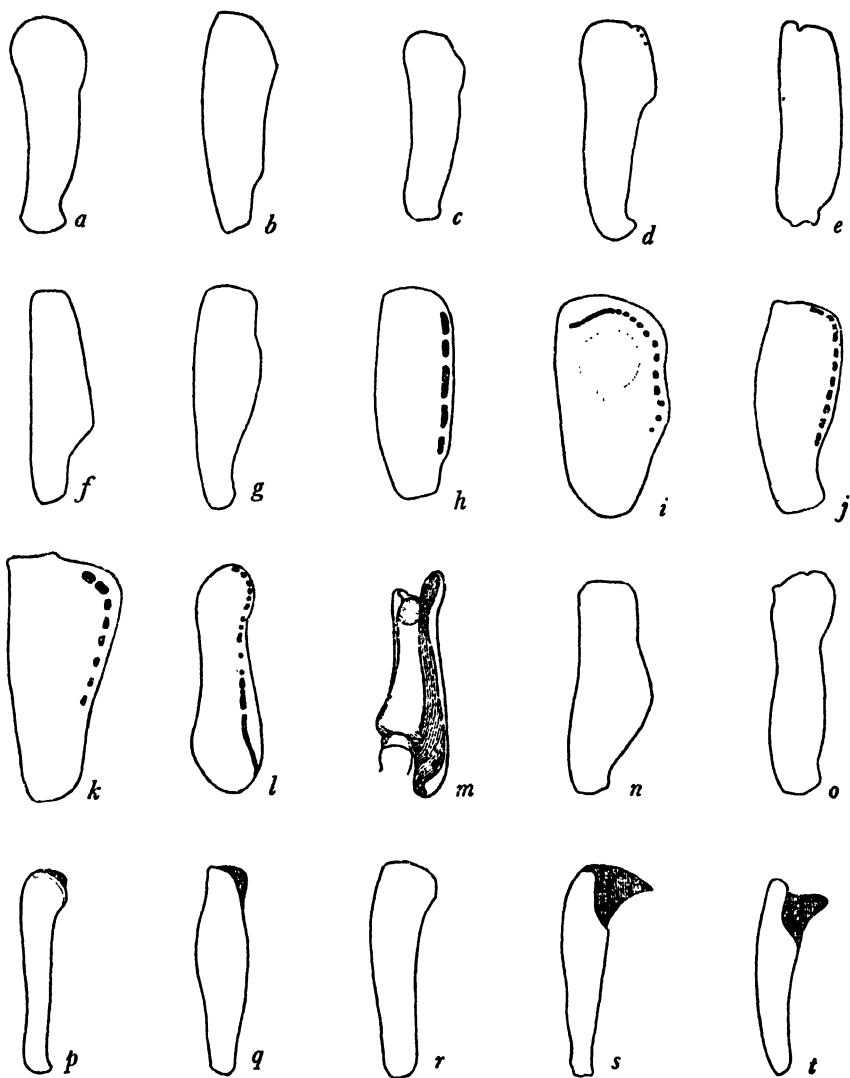


FIGURE 8.—See opposite page for explanation.

Male: 6 mm. Antennal scape (fig. 8, *c*); compound eyes prominent, projecting; malar space one-fourth height of compound eye; diameter of posterior ocellus one-half width of interocellar space; foretarsal claw (fig. 11, *b*); metafemur with a sharp inner tooth; petiole three times as long as wide; ninth sternite (fig. 14, *c*).

Type locality.—Oregon.

Types.—Holotype, female, Albert Lake, Oreg., July 2, 1935, J. Schuh; allotype, male, Fish Trap Lake, Wash., July 8, J. M. Aldrich; paratypes, Maxwell, N. Mex., 1916, G. W. Barber, 1 female; Albert Lake, Oreg., July 2, 1935, J. Schuh, 1 female; Emery County, Utah, September 12, 1921, Grace O. Wiley, 1 female; Colorado, 1 female. Holotype and allotype deposited in U. S. National Museum; one paratype, Cornell University; one paratype, Illinois State Natural History Survey; one paratype, University of Minnesota; one paratype, American Museum of Natural History.

Host.—Unknown.

CHALCIS FLEBILIS (Cresson)

FIGURES 8, *d*; 11, *c*; 14, *d*

Smicra flebilis CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 35, 39, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 34, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 377, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 35, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 75, 1916.

Spilochalcis flebilis (Cresson) JOHNSON, Biological survey of the Mount Desert region, vol. 1, p. 149, 1927.

The female of this typically northern species is most easily recognized by the conspicuously exerted hypopygium, which is isolated from the eighth tergite and by the metafemur lacking an inner tooth; the male is recognized at once by the spatulate antennal scape.

Description.—Black, the pronotum and mesoscutellum of female occasionally with indistinct yellow spots, legs more or less red, outer surface of metafemur with base and a ventral spot near apex white or light yellow.

Female: 4.5–6 mm. Antennae inserted in center of frons, apex of scape only slightly exceeding level of posterior ocelli, segment 4 one-third longer than 5; malar space slightly more than one-half height of compound eye; frontogenal suture slightly curved, almost straight; left mandible with one large dorsal and one very small ventral tooth, right mandible with three teeth, two ventral ones small, blunt and only indistinctly divided, dorsal tooth acute.

Prepectus narrow, apex not quite reaching tegula; mesotibial spur minute; outer surface of metafemur densely covered with short, fine pubescence, outer ventral margin with 12 to 16 minute teeth; basal

tooth only slightly larger than others; inner tooth absent; apex of metatibia elongate, sharp; apex of posterior tarsus with five to seven long setae; claws long, basal enlargement with one or two minute teeth.

Propodeum thickly covered by small carinae, spiracular openings vertical; petiole short, only slightly more than twice as long as wide, surface usually roughly ridged at base, a pair of small lateral sub-basal projections present; cerci round, located midway between anterior and posterior margins of epipygium; apex of ovipositor sheath constricted and provided with several long, slightly curved ventral setae; hypopygium strongly exserted, isolated from eighth tergite (as in fig. 13, *g*).

Male: 4–5.5 mm. Antennal scape spatulate (fig. 8, *d*); apical spur of mesotibia well developed; foretarsal claw with a series of long basal spines (fig. 11, *c*); metafemur without an inner tooth; ninth sternite narrowly emarginate at apex (fig. 14, *d*).

Type locality.—Massachusetts.

Type.—Holotype, male, 1778, Academy of Natural Sciences of Philadelphia.

Host.—Unknown.

Distribution.—Connecticut, Illinois, Maine, Massachusetts, Minnesota, New Hampshire, New Jersey, Ontario.

CHALCIS BARBARA (Cresson)

FIGURES 8, *e*; 11, *d*; 13, *g*; 14, *e*

Smicra barbara CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 37, 47, 192, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 33, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 373, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 34, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 74, 1916.

Smicra rufofemorata CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 36, 39, 191, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 35, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 234, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 381, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 36, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 76, 1916.—VIERECK, Connecticut Geol. and Nat. Hist. Surv. Bull. 22, p. 526, 1916.—BRITTON, *ibid.*, vol. 31, p. 326, 1920.

The female of this species is most readily recognized by the usually red dorsum of the thorax, the large acute inner tooth of the metafemur, and the conspicuously exserted hypopygium with the apex isolated from the eighth tergite; the male is always black, with the antennal scape uniformly expanded from base to apex, and the metafemur has a distinct inner tooth.

Description.—Dorsum of female more or less red, of male black; legs uniformly brown; abdomen varying from brown to black.

Female: 5-7.5 mm. Antennae inserted slightly ventrad of center of frons, apex of scape slightly exceeding level of posterior ocelli; malar space one-half height of compound eye; frontogenal suture extending ventrad from compound eye for one-half its length, then deflected sharply toward mandible; left mandible with one large blunt tooth and one minute acute ventral one, right mandible with three blunt teeth, dorsal one largest.

Prepectus narrow, bladelike, extending to tegula; mesotibial spur minute; outer surface of metafemur densely covered with long pubescence on ventral side, femoral teeth partly concealed by pubescence, outer ventral margin with 16 to 20 small teeth, basal one slightly larger than others; inner tooth large; apex of metatibia elongate, sharp; apex of posterior tarsus with three or four long spines; claw short and with several minute teeth on basal enlargement.

Propodeum provided with coarse reticulations, two laterobasal areas sometimes almost glabrous, spiracular openings vertical; petiole twice as long as wide, surface faintly reticulated, dorsal surface reticulated near base, distinct lateral carinae present; gaster usually shorter than metafemur; cerci oval, located midway between posterior and anterior margins of epipygium; ovipositor sheath flattened, ventral margin acute, apex acute and provided with a dense tuft of short setae; hypopygium strongly exserted, apex isolated from eighth tergite (fig. 13, *g*).

Male: 5-7 mm. Antennal scape (fig. 8, *e*); foretarsal claw with several long, comblike teeth on basal enlargement (fig. 11, *d*); metafemur with distinct inner tooth; ninth sternite broadly excavated on meson (fig. 14, *e*).

Type locality.—Texas.

Types.—Holotype, female, 1790.1, Academy of Natural Sciences of Philadelphia; paratypes, 1790.2, Academy of Natural Sciences of Philadelphia, 1651, U. S. National Museum, 2 females. The male was described as *Smicra rufofemorata* Cresson from Texas; types A.N.S.P. No. 1779 and U.S.N.M. No. 1657.

The species *Smicra barbara* Cresson was originally stated to be described from a male, but the types are females. As red female specimens agreeing with these types are uniformly found associated with black male specimens agreeing with the type of *rufofemorata* Cresson, they are undoubtedly the sexes of the same species.

Host.—*Odontomyia* sp. (Diptera, Stratiomyiidae).

Distribution.—Colorado, Illinois, Kansas, Minnesota, New Hampshire, New Jersey, North Dakota, Texas, Wyoming.

CHALCIS PHOENICAPODA, new name

Smicra rufipes KIRBY, Journ. Linn. Soc. London, Zool., vol. 17, p. 70, 1883.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 234, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 381, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 36, 1909.

The placing of this species in the genus *Chalcis* makes it a secondary homonym of *Chalcis rufipes* Olivier^{*}; a new name is therefore necessary.

This species is closely related to *Chalcis canadensis* (Cresson) but differs in that the left mandible has three, rather than two, teeth, and the petiole is three times as long as wide, completely glabrous dorsad, and lacks lateral carinae.

Description.—Black, with red-brown legs.

Female: 6.5 mm. Antennae inserted slightly ventrad of center of frons, apex of scape slightly exceeding level of posterior ocelli, segment 4 of antenna one and one-half times length of 5, segments 5 to 8 equal in length, 9 and 10 slightly shorter, 11 to 13 combined equal in length to 4; width of malar space one-half height of compound eye; frontogenal suture slightly curved, almost straight; combined widths of compound eyes three-fourths interocular space at level of antennal bases; left mandible with three blunt teeth, dorsal one largest.

Dorsum of thorax uniformly covered with deep pits; anterolateral angles of pronotum acute, anterior dorsal margin acarinate; prepectus bladelike, extending to tegula; apex of mesoscutellum provided with a minute, mesally depressed lamina; metacoxa glabrous, provided with a few inconspicuous setae; outer surface of metafemur minutely shagreened, ventral margin provided with 13 to 15 minute teeth, the basal one not larger than following teeth; inner tooth large, acute; claws of posterior tarsi elongate, slender, basal enlargement with a few minute teeth.

Propodeum provided with three strong carinae radiating obliquely laterad from meson, basolateral areas minutely reticulated, spaces between carinae glabrous, spiracular slits vertical; petiole three times as long as wide, surface glabrous, lateral carinae lacking, a pair of minute, lateral, subbasal projections present; gaster shorter than meta-femur, third abdominal tergite asetose, following tergites provided with long lateral setae; eighth tergite very lightly shagreened and sparsely setose; cerci located near posterior margin of epipygium; hypopygium with apex isolated from eighth tergite.

Male: Unknown.

Type locality.—Georgia.

^{*} Encyclopédie méthodique, vol. 5, p. 440, 1790.

Types.—Cotypes, 2 females, British Museum; one cotype kindly lent for study by Dr. Ferrière of that institution.

Host.—Unknown.

Distribution.—GEORGIA: 1 female (cotype). FLORIDA: Jacksonville, 2 females.

CHALCIS CANADENSIS (Cresson)

FIGURES 8, *f*; 11, *e*; 14, *f*

Smicra canadensis CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 35, 39, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 33, 1885.—PROVANCHER, Additions et corrections à la faune hyménoptérolologique. . . Canada, p. 189, 1887.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 374, 1898.—SCHMIEDERNECHT, Genera Insectorum, fasc. 97, p. 34, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 74, 1916.

Smicra microgaster HART, Illinois State Lab. Nat. Hist. Bull. 4, p. 271, 1894 (misidentification).

This species is most readily recognized in the female by the minute mesotibial spur, the short rugose petiole, and the exerted hypopygium with the apex not isolated from the eighth tergite (as in fig. 13, *f*); the male is recognized at once by the basally enlarged antennal scape (fig. 8, *f*).

Description.—Entirely black, or occasionally dark rufous; base of metafemora occasionally tinged with brown.

Female: 5–5.5 mm. Antennae inserted slightly ventrad of center of frons, scape exceeding by one-fifth its length level of posterior ocelli; width of malar space slightly more than one-half height of compound eye; frontogenal suture almost obliterated, occasionally traceable near ventral margin of compound eye, a secondary carina usually extends from base of mandible to genal area posterior to compound eye; left mandible with one large, acute dorsal tooth and one small ventral tooth, right mandible with three equal, acute teeth.

Prepectus narrow, bladelike, slightly broader anteriorly, apex not quite reaching tegula; mesotibial spur minute; outer surface of metafemur densely covered with short pubescence, outer ventral margin with nine to twelve minute teeth, basal one slightly larger than following teeth; inner tooth wanting; apex of metatibia slender, acute; apex of posterior tarsus provided with four to six long setae, claw small, basal enlargement with three minute teeth.

Propodeum completely covered with small reticulations, these rugosities slightly stronger near apex, spiracular openings vertical, slightly constricted in middle; petiole short, less than twice as long as wide, surface provided with coarse, confused carinae, distinct lateral carinae present at base, but usually becoming obsolete before reaching apex; gaster usually slightly longer than metafemur; cerci oval, situated near posterior margin of epipygium; apex of ovipositor sheath produced in a long, acute point, a sparse tuft of setae present;

hypopygium exerted, apex not isolated from eighth tergite (as in fig. 13, *f*).

Male: 4.5–5 mm. Antennal scape expanded at base (fig. 8, *f*); protarsal claw with a few teeth on basal enlargement (fig. 11, *e*); metafemur with pubescence on outer surface extremely short, inner tooth lacking or obscurely indicated; ninth sternite broadly excavated mesad (fig. 14, *f*).

Type locality.—Canada.

Type.—Holotype, female, 1783, Academy of Natural Sciences of Philadelphia.

Hosts.—*Odontomyia vertebrata* Say, *Odontomyia* sp. (Diptera, Stratiomyiidae).

Distribution.—ILLINOIS: 1 male; Algonquin, July 7–17, 1909, Nason, 1 female, 7 males; Havana, June 30, 1897, Hart and Bronson, 3 females, July 3, 1894; ex *Odontomyia vertebrata*, C. A. Hart, 1 male. MICHIGAN: Washtenaw County, June 13–19, 1931, ex *Odontomyia* sp., K. C. Kuster, 2 females, 1 male. NEW YORK: Penn Yan, July 19, 1925, Babiý, 1 male. ONTARIO: Ottawa, 1 female, 1 male.

CHALCIS MICROGASTER Say

FIGURES 8, *g*; 11, *f*, *i*; 13, *f*; 14, *g*

Chalcis microgaster SAY, Long's second expedition . . . , vol. 2, p. 326, 1824.—

CRESSON, Proc. Ent. Soc. Philadelphia, vol. 1, p. 228, 1862.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 36, 1885.

Smicra microgaster (Say) CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 35, 38, 1872; Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 223, 1887.—PROVANCHER, Additions et corrections à la faune hyménoptérologique . . . Canada, p. 189, 1887.—SMITH, Geol. Surv. New Jersey, Catalogue of insects, p. 18, 1890.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 379, 1898.—SMITH, Ann. Rept. New Jersey State Board Agr., vol. 27, suppl., p. 554, 1900.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 35, 1909.—VIERECK, Connecticut Geol. and Nat. Hist. Surv. Bull. 22, p. 526, 1916.

This species is most easily distinguished in the female by the large mesotibial spur, the long, nearly glabrous petiole, and the exerted hypopygium not isolated from the eighth tergite (fig. 13, *f*); the male is readily identified by its relatively slender antennal scape, and the two acutely projecting points on the posterior margin of the ninth sternite (fig. 14, *g*).

Description.—Black, the anterior and mesolegs variegated with brown, base of metafemur red-brown.

Female: 4–5 mm. Antennae inserted in center of frons, scape exceeding level of posterior ocelli by one-fourth its length; width of malar space slightly less than one-half height of compound eye; frontogenal suture straight, this suture often paralleled ventrally by a rather vague carina; left mandible with two teeth of nearly

equal size, right mandible with acute dorsal tooth and two rounded ventral ones.

Prepectus narrow, bladeliike, apex reaching tegula; mesotibial spur large; ventral half of outer surface of metafemur provided with dense, short pubescence, outer ventral margin with 13 to 16 teeth (fig. 11, *i*), basal one and usually fifth to tenth larger than others; distinct inner tooth present; apex of metatibia narrow, acute; apex of posterior tarsus with four long spines, claw small, basal enlarge-ment without teeth, but with several long setae.

Propodeum with two parallel, longitudinal mesal carinae, baso-lateral areas glabrous or almost so, spiracular openings vertical; petiole three times as long as wide, two-thirds length of metacoxa, surface almost glabrous, lateral carinae usually absent, occasionally present near base, a sparse row of long setae present on either lateral margin; gaster usually slightly longer than metafemur; cerci oval, located near posterior margin of epipygium, a smooth area surrounds each cercus; apex of ovipositor sheath bluntly pointed, provided with a tuft of short setae; hypopygium exserted, apex not isolated from eighth tergite (fig. 13, *f*).

Male: 3.5–4.5 mm. Antennal scape relatively narrow (fig. 8, *g*); protarsal claw with many small basal teeth (fig. 11, *f*); mesotibial spur usually small; metafemur with a small inner tooth; ninth sternite acutely bidentate at apex (fig. 14, *g*).

Type locality.—Pennsylvania.

Types.—Cresson redescribed the male of this species in 1872, but the specimens at present in the Academy of Natural Sciences of Philadelphia labeled "*Smicra microgaster*" are evidently not the ones he had, as they do not agree with his description, and are females. Provancher described the female in 1887; I have not seen his specimens.

Host.—Unknown.

Distribution.—Illinois, Minnesota, Oklahoma, Ohio, Ontario, Pennsylvania, Texas, Wisconsin.

Genus METADONTIA Ashmead

Metadontia ASHMEAD, Ent. Amer., vol. 4, p. 87, 1888.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 394, 1898.—ASHMEAD, Mem. Carnegie Mus., vol. 1, p. 252, 1904.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 32, 1909.—GAHAN and FAGAN, U. S. Nat. Mus. Bull. 124, p. 87, 1923. (Genotype, *Chalcis amoena* Say [= *Smicra montana* Ashmead].)

Plagiosmicra CAMERON, Invert. Pacifica, vol. 1, p. 56, 1904.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 31, 1909.—GAHAN and FAGAN, U. S. Nat. Mus. Bull. 124, p. 115, 1923.

Description.—Antennae inserted considerably ventrad of center of frons but dorsad of ventral margins of compound eyes; segments of

flagellum stout, mostly as broad as long, segment 4 always longer than 5; malar space narrow, always only one-third or less height of compound eye; left mandible with two teeth, right with three; pubescence of body long, sparse; procoxae, from lateral aspect, longer than wide; tarsal claws small, simple in both sexes; apical lamina of mesoscutellum very narrow and emarginate on meson; metacoxae semiglobose, outer dorsal surface glabrous; metafemora with several long, slender, slightly curved teeth on outer ventral margin; propodeum, from lateral aspect, strongly declivent, coarsely rugose, entirely without lateral projections; gaster elongate, blunt at apex (fig. 13, j); female hypopygium exserted, partly isolated from eighth tergite; ninth sternite of male obscurely emarginate at apex.

The single known species parasitizes pupae of Lycaenidae.

METADONTIA AMOENA (Say)

FIGURES 11, k; 13, j

- Chalcis amoena* SAY, Boston Journ. Nat. Hist., vol. 1, p. 271, 1836.—CRESSON, Proc. Ent. Soc. Philadelphia, vol. 1, p. 228, 1862.
- Smicra amoena* (Say) WALKER, Notes on Chalcididae, p. 51, 1871.—CRESSON, Trans. Amer. Ent. Soc., vol. 4, p. 58, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 33, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 373, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 34, 1909.
- Metadontia amoena* (Say) SANDERSON, U. S. Dept. Agr. Bur. Ent. Bull. 56, p. 42, 1906.
- Smicra montana* ASHMEAD, Trans. Amer. Ent. Soc., vol. 14, p. 183, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 379, 1898.
- Metadontia montana* (Ashmead) ASHMEAD, Mem. Carnegie Mus., vol. 1, p. 252, 1904.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 46, 1909.—GAHAN and FAGAN, U. S. Nat. Mus. Bull. 124, p. 87, 1923.
- Plagiosmicra ashmeadi* CAMERON, Invert. Pacifica, vol. 1, p. 56, 1904.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 44, 1909.—GAHAN and FAGAN, U. S. Nat. Mus. Bull. 124, p. 115, 1923.
- Octosmicra* sp. REINHARD, Texas Agr. Exp. Stat. Bull. 401, p. 33, 1929.

This species is most readily recognized by the broad compact thorax, the completely carinate anterior dorsal margin of the pronotum, and the blunt apex of the abdomen.

Description.—Yellow with black markings; mesal stripe in scrobe cavity, occipital area of head, mesopraescutum usually with two anterior stripes converging to form a single mesal stripe near posterior margin, broad mesal areas of lobes of mesoscutum, anteromesal angles and posterior margins of axillae, longitudinal mesal stripe of mesoscutellum, variable areas of pleurae, ventral apices of metacoxae, metatrochanters usually, dorsal, basoventral, and apical spots on outer surface of metafemora, usually entire propodeum, petiole, and variable transverse dorsal bands of gaster, black.

Female: 6-7.5 mm. Apex of antennal scape just reaching level of posterior ocelli, flagellar segments stout; scrobe cavity deep, margins carinate on ventral half; frons punctate laterally, glabrous or very faintly shagreened mesally ventrad of antennal bases, lateral carinae present parallel with anterior margins of compound eyes; interantennal projection carinate; frontal tentorial pits located dorso-laterad of antennal bases; width of malar space one-third height of compound eye; frontogenal suture straight or very slightly curved; left mandible with two acute teeth, right with three; combined widths of compound eyes equal to interocular space at level of antennal bases.

Dorsum of thorax thickly covered with large punctures, pubescence short, white or yellow; entire anterior dorsal margin of pronotum carinate; prepectus extending to tegula; apex of mesoscutellum with a narrow, mesally depressed lamina; mesotibia with distinct apical spur; metepisternum punctate anteriorly, glabrous near posterior margin, outer dorsal surface of metacoxa slightly flattened, glabrous; outer surface of metafemur glabrous, setae short, sparse, outer ventral margin provided with seven to ten irregular teeth, four or five of which are long, slender, and slightly curved (fig. 11, *k*); inner tooth minute or lacking.

Propodeum covered with confused carinae, spaces between carinae glabrous, spiracular openings vertical, much wider at top than at bottom; petiole glabrous, twice as long as wide, basal flange wide on dorsal and ventral sides and narrow laterad, lateral carinae usually present; gaster slightly longer than metafemur; eighth abdominal tergite minutely pitted, sparsely setose; cerci oval or almost round, located near posterior margin of epipygium; hypopygium exerted, apex not isolated from eighth tergite (fig. 13, *j*).

Male: 4.5-6 mm. Width of malar space one-quarter height of compound eye; combined widths of compound eyes slightly greater than width of interocular space at level of antennal bases; inner tooth of metafemur generally wanting, occasionally faintly indicated; petiole two and one-half to three times as long as wide, lateral carinae obscure or wanting.

Type locality.—Indiana.

Types.—Neotype, female, Arlington, Tex., September 4, 1905, ex *Strymon cecrops*, F. C. Bishopp, deposited in the U. S. National Museum. Synonyms: *montana* Ashmead, U.S.N.M. No. 41397; *ashmeadi* Cameron, British Museum.

The type of *montana* Ashmead differs from what I take for this species only in lacking the anteromesal yellow spot on the mesopraescutum, but such a character is never of specific worth in this group; *ashmeadi* Cameron differs neither in color nor in structure from this species.

Hosts.—*Strymon melinus* (Hübner), *Strymon cecrops* (Fabricius), *Thecla* sp. (Lepidoptera, Lycaenidae).

Distribution.—Arizona, Arkansas, California, District of Columbia, Florida, Georgia, Illinois, Kansas, Missouri, North Carolina, Tennessee, Texas, Virginia.

Guatemala, Nicaragua, Trinidad, B. W. I.

Genus *SPILOCHALCIS* Thomson

Chalcis FABRICIUS, *Mantissa Insectorum* . . . , vol. 1, p. 272, 1787 (in part).—

WESTWOOD, An introduction to the modern classification of insects, p. 65, 1840.—PACKARD, Guide to the study of insects . . . , p. 203, 1872.

Smiera SPINOLA, *Ann. Mus. Hist. Nat.*, vol. 17, p. 147, 1811 (in part).—WALKER, *Ent. Mag.*, vol. 2, p. 20, 1835.

Smiera SPINOLA, *Mag. Zool.*, vol. 7, p. 180, 1837 (in part).—WALKER, Notes on Chalcidae, p. 40, 1871.—CRESSON, *Trans. Amer. Ent. Soc.*, vol. 4, p. 35, 1872; *Biologia Centrali-Americana*, Hymenoptera, vol. 1, p. 78, 1883.

Conura, "*Conurae smicriformes*," "*Conurae chalcidiformes*"^{*} SICHEL, *Ann. Soc. Ent. France*, ser. 4, vol. 5, p. 347, 1865.

Phasganophora "*Phasganophorae smicriformes*"^{*} SICHEL, *ibid.* p. 348.

Spilochalcis THOMSON, *Hymenoptera Scandinaviae*, vol. 4, p. 15, 1875.—KIRBY, *Journ. Linn. Soc. London, Zool.*, vol. 17, p. 55, 1883.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 3, 1885; *Ent. Amer.*, vol. 1, p. 215, 1886.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 67, 1887.—ASHMEAD, *Ent. Amer.*, vol. 4, p. 87, 1888.—DALLA TORRE, *Catalogus hymenopterorum*, vol. 5, p. 384, 1898.—ASHMEAD, *Mem. Carnegie Mus.*, vol. 1, p. 250, 1904.—SCHMIEDEKNECHT, *Genera insectorum*, fasc. 97, p. 30, 1909.—VIERECK, *Connecticut Geol. and Nat. Hist. Surv. Bull.* 22, p. 527, 1916.—GAHAN and FAGAN, *U. S. Nat. Mus. Bull.* 124, p. 135, 1923.—MANT, *Rec. Indian Mus.*, vol. 37, p. 251, 1935. (Genotype, *Chalcis xanthostigma* Dalman.)

Spilosmicra CAMERON, *Trans. Amer. Ent. Soc.*, vol. 35, p. 422, 1910.

Diplodontia ASHMEAD, *Ent. Amer.*, vol. 4, p. 87, 1888.—DALLA TORRE, *Catalogus hymenopterorum*, vol. 5, p. 394, 1898.—ASHMEAD, *Mem. Carnegie Mus.*, vol. 1, p. 252, 1904.—SCHMIEDEKNECHT, *Genera insectorum*, fasc. 97, p. 32, 1909.—GAHAN and FAGAN, *U. S. Nat. Mus. Bull.* 124, p. 47, 1923.

Eustypiura ASHMEAD, *Mem. Carnegie Mus.*, vol. 1, p. 251, 1904.—SCHMIEDEKNECHT, *Genera insectorum*, fasc. 97, p. 30, 1909.—GAHAN and FAGAN, *U. S. Nat. Mus. Bull.* 124, p. 64, 1923.

Enneasmicra ASHMEAD, *Mem. Carnegie Mus.*, vol. 1, p. 252, 1904.—SCHMIEDEKNECHT, *Genera insectorum*, fasc. 97, p. 31, 1909.—GAHAN and FAGAN, *U. S. Nat. Mus. Bull.* 124, p. 51, 1923.

Octosmicra ASHMEAD, *Mem. Carnegie Mus.*, vol. 1, p. 252, 1904.—SCHMIEDEKNECHT, *Genera insectorum*, fasc. 97, p. 31, 1909.—GAHAN and FAGAN, *U. S. Nat. Mus. Bull.* 124, p. 98, 1923.

Heptasmicra ASHMEAD, *Mem. Carnegie Mus.*, vol. 1, p. 252, 1904.—SCHMIEDEKNECHT, *Genera insectorum*, fasc. 97, p. 31, 1909.—GAHAN and FAGAN, *U. S. Nat. Mus. Bull.* 124, p. 70, 1923.

Hexasmicra ASHMEAD, *Mem. Carnegie Mus.*, vol. 1, p. 252, 1904.—SCHMIEDEKNECHT, *Genera insectorum*, fasc. 97, p. 32, 1909.—GAHAN and FAGAN, *U. S. Nat. Mus. Bull.* 124, p. 71, 1923.

^{*} These names have priority over *Spilochalcis* but are not binomial.

- Pentasmicra* ASHMEAD, Mem. Carnegie Mus., vol. 1, p. 252, 1904.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 32, 1909.—GAHAN and FAGAN, U. S. Nat. Mus. Bull. 124, p. 112, 1923.
- Tetrasmicra* ASHMEAD, Mem. Carnegie Mus., vol. 1, p. 252, 1904.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 32, 1909.—GAHAN and FAGAN, U. S. Nat. Mus. Bull. 124, p. 143, 1923.
- Trismicra* ASHMEAD, Mem. Carnegie Mus., vol. 1, p. 252, 1904.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 32, 1909.—GAHAN and FAGAN, U. S. Nat. Mus. Bull. 124, p. 149, 1923.

Description.—Antennae inserted ventrad of center of frons; antennal scape of male more or less broadened, scape of female slender; flagellar segments varying from stout to slender; left mandible typically with two teeth, occasionally with three, right mandible usually with three teeth, although division of two ventral ones may be obscure; anterior dorsal margin of pronotum never completely carinate; mesoscutellum provided with an apical lamina, this lamina, in most species, emarginate on meson; protarsal claws never bifid at apex, basal enlargement with or without small teeth; metatibia with distinct apical spine; metacoxae slightly flattened and asetose on outer dorsal surface; metafemur with 3 to 28 teeth on outer ventral margin; petiole varying from shorter than wide to three and one-half times as long as wide; ovipositor arising far forward, female abdomen always more or less acuminate; ninth sternite of male never emarginate at apex, occasionally slightly excavated on meson.

All the species of this genus that have been reared are parasites of the pupae of Lepidoptera, Coleoptera, Hymenoptera, or, rarely, cyclorrhaphous Diptera. The genotype, the European species *Spilochalcis xanthostigma* (Dalman), was stated by Walker¹⁰ to parasitize a sawfly of the genus *Hylotoma* [= *Arge* of present-day usage].

KEY TO GROUPS OF SPECIES OF SPILOCHALCIS

1. Apex of mesoscutellum bidentate (fig. 10, *e*); both mandibles with only two teeth..... transitiva group (p. 265)
- Apex of mesoscutellum not bidentate (fig. 10, *b*); right mandible always with three teeth..... 2
2. Frontogenal suture wanting, clypeus only slightly wider than long (fig. 7, *e*); antennal sockets often on a line with ventral margins of compound eyes..... side group (p. 326)
- Frontogenal suture present, clypeus always at least twice as wide as long (fig. 7, *a, f*); antennal sockets always dorsad of ventral margins of compound eyes..... 3
3. Antennal scape short, apex never reaching level of ventral margin of anterior ocellus..... xanthostigma group (p. 307)
- Antennal scape long, apex at least reaching level of vertex, usually markedly exceeding level of vertex..... 4

¹⁰ Ent. Mag., vol. 3, p. 22, 1835.

4. Metanotum and propodeum uniformly and densely covered with long setae; abdomen strongly compressed----- *nigricornis* group (p. 278)
 Metanotum sparsely setose, propodeum usually with only a few setae at lateral margins, disk of propodeum always entirely without setae; abdomen not compressed----- *femorata* group (p. 291)

These groupings of species have been made solely for convenience in their treatment. The groups are not sufficiently distinct to be considered as separate genera, for when specimens from the Neotropical area are studied intergrades are to be found between these groups.

The transitiva Group

All the members of the *transitiva* group have distinct lateral carinae on the frons parallel to the anterior margins of the compound eyes; the scrobe cavity is deep and the margins are distinctly carinate; the malar space is quite narrow, one-third or less the height of the compound eye; the metafemora have, with one exception, only four teeth; one species has (see fig. 12, *e*) acquired one or two additional small teeth near the base, and the large apical tooth is rather indistinctly subdivided.

The *transitiva* group includes those members of the genus that may be considered the most primitive. The genus *Spilochalcis* is undoubtedly derived from some ancestral form having slender metafemora. A few large teeth were probably developed first on the ventral margin, and later these large teeth were replaced by a number of smaller ones; at the same time, the femora gradually became much thickened. One species of this group, *S. exornata* (Cresson), has rather slender metafemora and four large teeth (fig. 12, *a*). In other species the gradual increase in width of the metafemur can be seen (fig. 12, *b-d*), and in *S. phoenica* described below and the extralimital species *S. compactilis* (Cresson), the transition to a form with many small teeth can be seen. In these two species the addition of small teeth at the base and the beginning of the subdividing of the large apical tooth have occurred (fig. 12, *e*).

KEY TO SPECIES OF THE TRANSITIVA GROUP

1. Outer basal tooth of metafemur larger and longer than others (fig. 12, *b*)----- *eubule* (p. 269)
 Outer basal tooth of metafemur not larger than others----- 2
2. Metafemur elongate, narrow (fig. 12, *a*)----- *exornata* (p. 266)
 Metafemur semiglobose (fig. 12, *c-e*)----- 3
3. Outer ventral margin of metafemur with only four teeth----- 4
 Outer ventral margin of metafemur with six or seven teeth, apical ones obscure (fig. 12, *e*)----- *phoenica* (p. 276)
4. Outer basal tooth of metafemur small (fig. 12, *c*)----- *dorsata* (p. 272)
 Outer basal tooth of metafemur large (fig. 12, *d*)----- *transitiva* (p. 274)

SPILOCHALCIS EXORNATA (Cresson)

FIGURES 8, *h*; 12, *a*

Smicra exornata CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 38, 50, 1872.—CAMERON, Biologia Centrali-Americana, Hymenoptera, vol. 1, p. 81, 1884.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 34, 1885.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 376, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 35, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 75, 1916.

This slender yellow-and-black species is most easily recognized by its almost completely glabrous frons and its elongate, slender meta-femora, with only four teeth on the outer ventral margin (fig. 12, *a*).

Description.—Yellow or red with black markings; antennal flagellum usually darker toward apex; mesopraescutum with a T-shaped mark, mesal margins of lobes of mesoscutum, axillae on mesal half, mesoscutellum usually with a longitudinal mesal line, and apex, apices of metacoxae, and three spots on metafemur, black.

Female: 6–7 mm. Antennal scape strongly curved near base, apex reaching level of ventral margin of anterior ocellus, pedicel slightly less than one-half length of segment 4, ring segment one-sixth length of 4, segment 4 one-eighth longer than 5, segments 5 to 10 equal, last three segments indistinctly separated, penultimate segment shortest; scrobe cavity with margin feebly carinate; interantennal projection with a thin, anterior lamina; lateral carinae completely encircling compound eyes; frons usually without punctures, sometimes with a

FIGURE 9.—Male antennal structures of Chalcidini (all mesal aspect).

- a*, *Spilochalcis clora*, new species: Scape.
- b*, *Spilochalcis phais*, new species: Scape.
- c*, *Spilochalcis tanais*, new species: Scape.
- d*, *Spilochalcis juxta* (Cresson): Scape.
- e*, *Spilochalcis arcana* (Cresson): Scape.
- f*, *Spilochalcis lecta* (Cresson): Scape.
- g*, *Spilochalcis melana*, new species: Scape.
- h*, *Spilochalcis odontotae* Howard: Scape.
- i*, *Spilochalcis subobsoleta* (Cresson): Scape.
- j*, *Spilochalcis pallipes* (Smith): Scape.
- k*, *Spilochalcis dema*, new species: Scape.
- l*, *Spilochalcis flavopicta* (Cresson): Scape and pedicel.
- m*, *Spilochalcis side* (Walker): Scape and pedicel.
- n*, *Spilochalcis leptis*, new species: Scape and pedicel.
- o*, *Spilochalcis delumbis* (Cresson): Scape and pedicel.
- p*, *Ceratismicra debilis* (Say): Scape.
- q*, *Ceratismicra meteori*, new name: Scape.
- r*, *Ceratismicra paya*, new species: Scape.
- s*, *Ceratismicra immaculata* (Cresson): Scape.
- t*, *Spilochalcis igneoides* (Kirby): Pedicel, ring segment, and segment 4.
- u*, *Spilochalcis mariae* (Riley): Pedicel, ring segment, and segment 4.

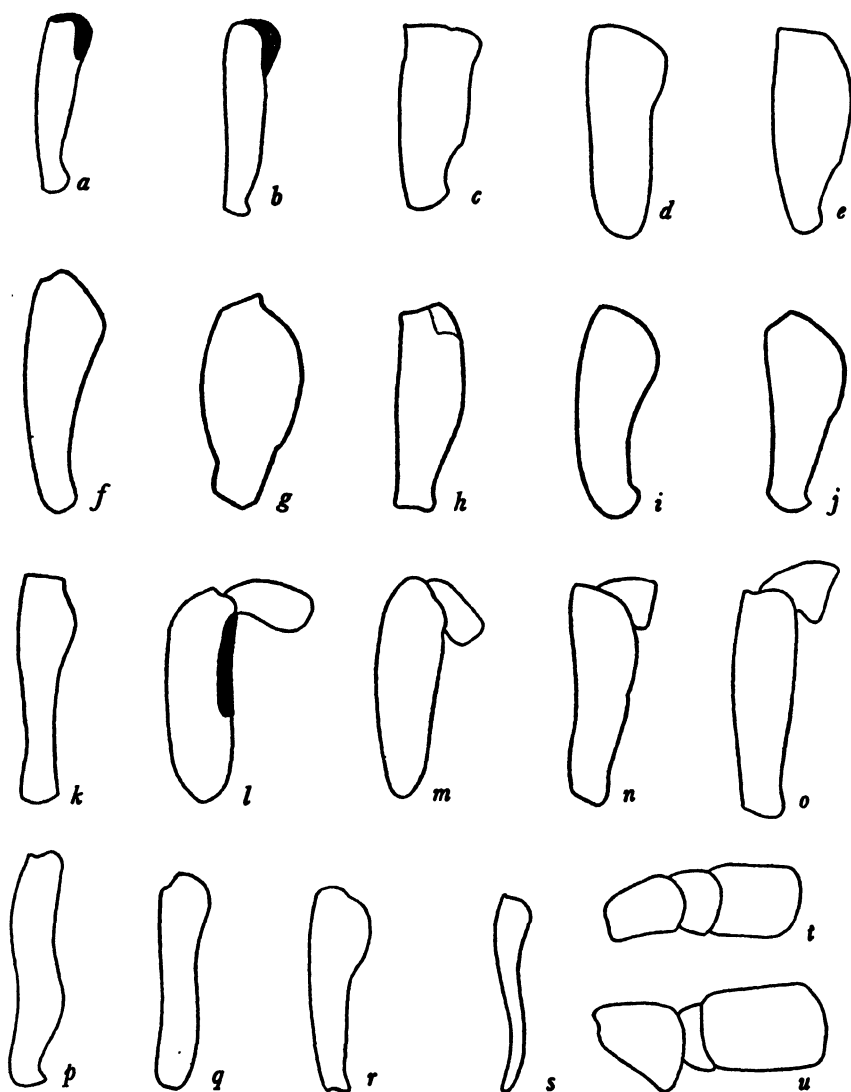


FIGURE 9.—See opposite page for explanation.

few scattered ones and with a few indistinct oblique carinae ventrad of antennal bases; frontal tentorial pits located at margins of compound eyes, slightly dorsad of level of antennal bases; width of malar space slightly less than one-third height of compound eye; fronto-genal suture extending transversely from compound eye to dorsal articulation of mandible; combined widths of compound eyes greater by one-third than width of interocular space at level of antennal bases; diameter of posterior ocellus one-half width of interocellar space.

Dorsum of thorax coarsely pitted, uniformly covered by long yellowish setae; anterolateral angles of pronotum strongly produced; anterior dorsal carina interrupted on mesal one-third; parapsidal furrows partly obliterated; prepectus usually completely hidden by anterior projection of lateral margin of mesoscutum; apex of mesoscutellum strongly bidentate, the projections slightly upturned and a small dorsal carina present on each; metepisternum covered by large, shallow punctures, areas between punctures minutely reticulated; metacoxae glabrous, covered, except on outer dorsal side, by long, fine setae; metafemora (fig. 12, *a*) narrow, glabrous, scatteringly covered by setae of various lengths, outer ventral basal tooth nearly as long as following ones, a minute tooth often present between basal and second tooth; second and third teeth long, narrow, acute, apical tooth large, blunt; inner tooth wanting; metatibia with apical spine long, acutely pointed.

Propodeum with only a few long, lateral setae, and a patch of short setae on each side near base; carinae few, often partly or completely obliterated near base and on disk; one strong roundly blunted lateral tooth present on either side of point of insertion of petiole, spiracular opening slanted obliquely laterad; petiole glabrous, basal lamina present only on ventral and lateral sides, lateral carinae wanting, a few lateral setae present near apex; gaster usually slightly shorter than metafemur; abdominal tergites 3 to 7 with a few scattered lateral setae; eighth tergite faintly reticulated, sparsely covered by long setae; spiracular openings round; cercus obovate, located midway between anterior and posterior margins of epipygium; apex of ovipositor sheath provided with long ventral setae.

Male: 6 mm. Antennal scape (fig. 8, *h*) uniformly broad from base to apex; combined widths of compound eyes equal to interocular space at level of antennal bases; inner tooth of metafemur wanting; gaster usually slightly larger than metafemur.

Type locality.—Mexico.

Types.—Holotype, male, 1817.1; allotype, female, 1817.2; paratypes, 1817.3, 1817.4, 2 males: Academy of Natural Sciences of Philadelphia.

Host.—(?) *Mimorista flavidissimalis* Grote (Lepidoptera, Pyralidae).

Distribution.—TEXAS: Brownsville, November 21–December 17, 1910, 2 females, 3 males, November 19–25, 1911, 3 females, January 18, 1923, T. C. Barber, 1 female; Uvalde, June 1921, ex *Mimorista flavidissimalis* (?), J. C. Hamlin, 1 female.

MEXICO: Sumichrast, 1 female, 1 male (allotype and holotype), 2 males (paratypes).

HONDURAS: La Ceiba, April 14, 1917, F. J. Dyar, 1 female.

SPILOCHALCIS EUBULE (Cresson)

FIGURES 8, *i*; 12, *b*

Smicra eubule CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 93, 1865; The Cresson types of Hymenoptera, p. 74, 1916.—WOLCOTT, Journ. Dept. Agr. Puerto Rico, vol. 7, p. 61, 1924; Journ. Agr. Univ. Puerto Rico, vol. 20, p. 537, 1936.

Smicra eubule (Cresson) WALKER, Notes on Chalcididae, p. 51, 1871.—CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 37, 49, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 34, 1885.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 376, 1898.—ASHMEAD, Trans. Ent. Soc. London, vol. 48, p. 336, 1900.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 35, 1909.

This large species is most readily distinguished by the very narrow malar space, the antennae inserted low on the frons, but well above the ventral margins of the compound eyes, and the metafemur having only four teeth, the basal one of which is larger than the others.

Description.—Red, light brown, or yellow with dark brown markings; small dorsal spots near lateral margins of pronotum, center of mesopraescutum and mesal margins of lobes of mesoscutum, axillae, mesal stripe and apex of mesoscutellum, apices of metacoxae, dorsal and variable ventral stripes on outer side of metafemora, and most of abdomen, usually dark; apical half of wings slightly darker than basal half.

Female: 8–10 mm. Antennal scape short, stout, markedly expanded at apex, reaching to level of ventral margin of anterior ocellus, pedicel slightly less than one-half length of segment 4, ring segment one-tenth or less length of fourth segment, segment 4 slightly longer than 5, segments 5 to 10 nearly equal, tapering slightly, segment 11 slightly wider at base than 10, 12 and 13 shorter, narrow; scrobe cavity deep, smooth, margin carinate, this margin enclosing anterior ocellus; interantennal projection provided with a large, thin, anterior lamina; frons scatteringly punctured laterad of scrobe cavity, almost glabrous ventrad of antennal bases; anterior tentorial pits located near margin of compound eyes, slightly dorsad of level of antennal bases; lateral carinae present on frons laterad of scrobe cavity; malar space one-eighth height of compound eye; combined

widths of compound eyes slightly greater than interocular width at level of antennal bases; diameter of posterior ocellus two-thirds width of interocellar space.

Dorsum of thorax coarsely punctate, pubescence long, yellow or white; anterior margins or pronotum strongly carinate laterad, anterior dorsal carina narrowly interrupted on meson; prepectus small, not reaching tegula; mesoscutellum with a small mesal notch on anterior margin, apex conspicuously bidentate, these projections sharp, slightly converging; metepisternum strongly punctured, provided with a few scattered setae; metacoxa glabrous, sparsely setose on outer ventral side; metafemur (fig. 12, *b*) glabrous, sparsely setose, outer basal ventral tooth large, second and third teeth long, slender, apical tooth blunt; inner tooth wanting; metatibia with apical spine sharp, narrow, slightly curved.

Propodeum setose, strongly carinate, prominent lateral teeth present at posterolateral angle of propodeum, spiracular openings nearly vertical; petiole short, stout, glabrous, lateral carinae wanting; basal lamina wide on ventral side; gaster slightly longer than metacoxa, abdominal segments 3 to 7 with lateral setae; spiracular openings on eighth tergite large, anterior margins straight; eighth tergite glabrous, without setae; cercus small, nearly round, located midway between anterior and posterior margins of epipygium; ovipositor sheath setose at apex.

Male: 8 mm. Antennal scape broad (fig. 8, *i*), inner tooth of metafemur absent; metatibia with apex usually slightly blunted.

Type locality.—Cuba.

FIGURE 10.—Thoracic structures and wings of Chalcidini.

- a*, *Leucospis dorsigerg* Fabricius: Thorax, lateral aspect. (*MEp*, mesoepimeron; *MEps*, mesoepisternum; *MPs*, mesopraescutum; *MS*, mesoscutum; *MSc*, mesoscutellum; *MtEps*, metepisternum; *MW*, forewing; *Pn*, pronotum; *Pr*, propodeum; *Sp*, spiracle; *Tg*, tegula.)
- b*, *Spilochalcis tanais*, new species: Thorax, dorsal aspect. (*Ax*, axilla; *Pa*, parapsidal furrow; *Pn*, pronotum; *MPs*, mesopraescutum; *Ms*, mesoscutum; *Msc*, mesoscutellum; *SSC*, scutoscuteellar suture; *T*, transscutal suture.)
- c*, *Spilochalcis apatis*, new species: Thorax, dorsal aspect.
- d*, *Ceratasmicra paya*, new species: Thorax, dorsal aspect.
- e*, *Spilochalcis dorsata* (Cresson): Mesoscutellum, dorsal aspect.
- f*, *Ceratasmicra meteori*, new name: Thorax, dorsal aspect.
- g*, *Leucospis affinis* Say: Forewing. (*C*, costal vein; *Cu*, cubital vein; *M*, medial vein; *Mv*, marginal vein; *R*, radial vein; *Rs*, radial sector; *Rs₁*, anterior branch of radial sector; *Sc*, subcostal vein; *St*, stigmal vein.)
- h*, *Spilochalcis delicata* (Cresson): Stigmal vein.
- i*, *Spilochalcis nigricornis* (Fabricius): Hamuli.
- j*, *Spilochalcis nortoni* (Cresson): Hamuli.
- k*, *Spilochalcis mariae* (Riley): Stigmal vein.

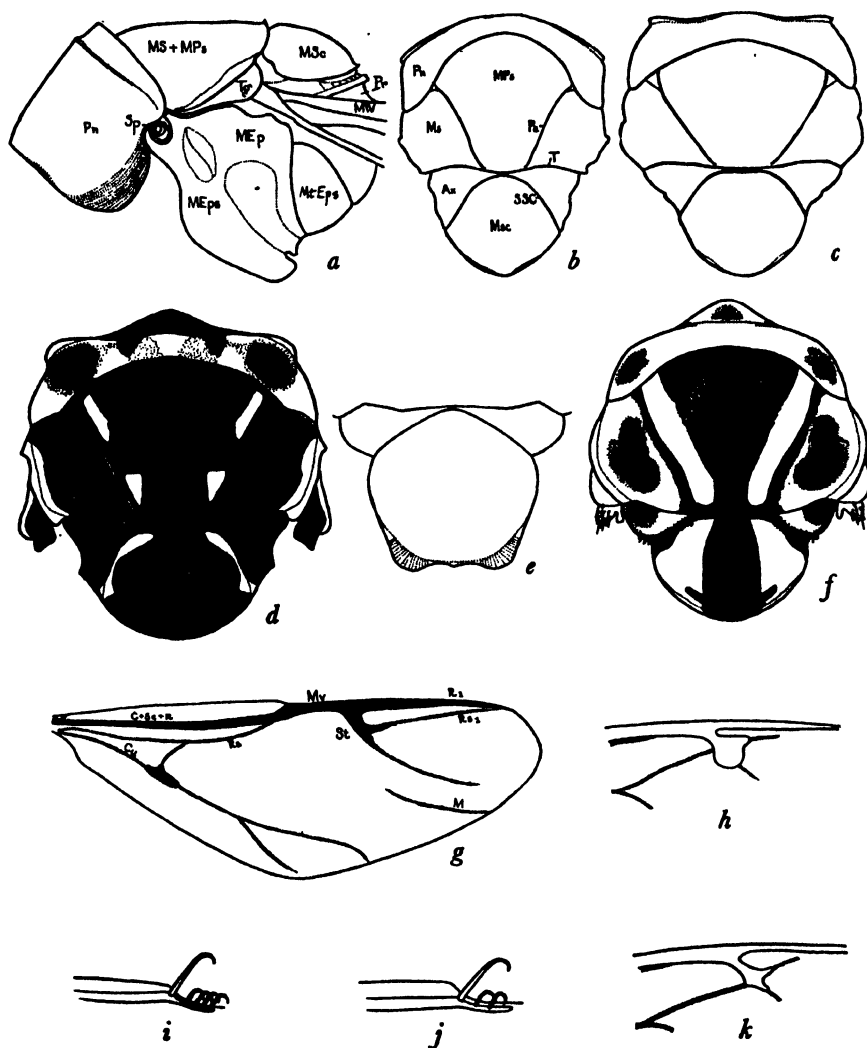


FIGURE 10.—See opposite page for explanation.

Types.—Holotype, female, 1814.1; allotype, male, 1814.2; paratype, 1814.3, 1 female: Academy of Natural Sciences of Philadelphia.

Host—*Catopsilia eubule* (Linnaeus) (Lepidoptera, Pieridae).

Distribution.—GEORGIA: Bainbridge, July 15, 1919, J. C. Bradley, 1 female; DeWitt, July 22, 1912, M. D. Leonard, 1 female.

CUBA: 134, ex *Catopsilia eubule*, 2 females, 1 male (types); Guantanamo, 1 male.

HAWAII: July 5, 1931, M. Kislink, 1 female.

PUERTO RICO: Aibonito, July 14, 1914; 1 female; Arecibo, March 13, 1934, Anderson and Mills, 1 male; Ponce, August 19, 1932, Bofill and Oakley, 1 male; Santa Rita, 1915, 2 females.

SPILOCHALCIS DORSATA (Cresson)

FIGURES 8, *f*; 10, *e*; 12, *c*

Smicra dorsata CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 37, 49, 192, 1872.—

HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 34, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 376, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 34, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 74, 1916.

Spilochalcis missouriensis HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, pp. 6, 35, 1885.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 385, 1898.—

SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 40, 1909.

Smicra missouriensis (Howard) CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 234, 1887.

This yellow, or red, and black species is most easily recognized by its large compound eyes, the widely spaced apical projections of the mesoscutellum, and the semiglobose metafemora with only four outer ventral teeth, the basal one minute.

Description.—Yellow or red with black markings; mesopraescutum except lateral and posterior margins, mesal margins of lobes of mesoscutum, mesal halves of axillae, anterior margin of mesoscutellum, apices of metacoxae, three small marks on outer side of metafemora, most or all of propodeum, and usually petiole, black; markings of mesopraescutum vary considerably.

Female: 5-6 mm. Apex of antennal scape not quite reaching level of ventral margin of anterior ocellus; pedicel two-fifths and ring segment one-fifth length of segment 4, 5 slightly shorter than 4; segments 5 to 10 equal, 11 slightly shorter, 12 shorter than 11, 13 equal to 11; scrobe cavity deep, marginal carina vague except ventrally; interantennal projection provided with a thin anterior lamina; lateral carinae usually completely encircling compound eyes, sometimes interrupted on vertex; frons scatteringly punctured except dorsad of clypeus; frontal tentorial pits located at margins of compound eyes at level of antennal bases; width of malar space

one-third height of compound eye; frontogenal suture extending transversely from compound eye to dorsal articulation of mandible; combined widths of compound eyes one-half greater than width of interocular space at level of antennal bases; diameter of posterior ocellus one-half interocellar width.

Dorsum of thorax coarsely punctured, anterolateral angles of pronotum strongly carinate, almost laminate, anterior dorsal margin with carina interrupted on mesal one-quarter; parapsidal furrows partly obliterated; prepectus entirely concealed by a hooklike projection of anterodorsal angle of mesoscutum; mesoscutellum bidentate at apex, these projections small, upturned, usually acutely pointed; metepisternum conspicuously pitted, densely covered by long setae; metacoxae glabrous, setose except on outer dorsal side; metafemora (fig. 12, *c*) glabrous, rather sparsely covered by short pubescence, semiglobose, outer ventral basal tooth one-fourth to one-third size of following teeth, second and third teeth long, slender, slightly curved, apical tooth large, blunt; inner tooth wanting; metatibia with apex long, sharp, slightly curved.

Propodeum sparsely covered by long pubescence, conspicuously carinate; two lateral teeth present on either side, one rather blunt, upturned, located at each posterolateral angle, others on either side of insertion of petiole, spiracular openings nearly vertical; petiole glabrous, slightly less than three times as long as wide at widest point, several long setae present on each lateral margin near base, lateral carinae lacking, basal lamina broad on ventral side, indistinct or wanting on dorsal side; gaster shorter than metafemur; abdominal tergites 3 to 7 with sparse lateral setae; eighth tergite very faintly reticulated, sparsely covered by short setae; spiracular openings with anterior margins straight; cerci oval, located near anterior margin of epipygium; apices of ovipositor sheaths provided with long setae on ventral side.

Male: 4.5–5 mm. Antennal scape (fig. 8, *j*) slightly broader at apex than base; combined widths of compound eyes one-third greater than interocular space at level of antennal bases; inner tooth of metafemur wanting; petiole three times as long as wide.

Type locality.—Texas.

Types.—Holotype, female, 1791, Academy of Natural Sciences of Philadelphia. Synonym: *missouriensis* Howard, U.S.N.M. No. 2622.

The type of *S. missouriensis* Howard differs from the type of *S. dorsata* (Cresson) only in being red instead of yellow.

Host.—Unknown.

Distribution.—Florida, Illinois, Kansas, Missouri, North Carolina, Texas.

SPILOCHALCIS TRANSITIVA (Walker)

FIGURES 8, *k*; 12, *d*

- Smiera transitiva* WALKER, Trans. Ent. Soc. London, vol. 20, pp. 345, 371, 1862.
- Smiera transitiva* (Walker) WALKER, Notes on Chalcididae, p. 51, 1871.—CRESSON, Trans. Amer. Ent. Soc., vol. 4, p. 57, 1872.—KIRBY, Journ. Linn. Soc. London, Zool., vol. 17, p. 66, 1883.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 36, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 234, 1887.
- Spilochalcis transitiva* (Walker) HOWARD, Journ. Linn. Soc. London, Zool., vol. 26, p. 130, 1896.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 385, 1898.—ASHMEAD, Trans. Ent. Soc. London, vol. 48, p. 336, 1900.—SCHMIEDER-KNECHT, Genera insectorum, fasc. 97, p. 41, 1909.
- Smiera pulchra* CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 94, 1865; The Cresson types of Hymenoptera, p. 76, 1916.
- Smiera pulchra* (Cresson) WALKER, Notes on Chalcididae, p. 51, 1871.—CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 38, 50, 1872.—CAMERON, Biologia Centrali-Americana, Hymenoptera, vol. 1, p. 79, 1883.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 35, 1885.—ASHMEAD, Trans. Amer. Ent. Soc., vol. 13, p. 125, 1886.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 234, 1887.

This yellow, or red, and black species is very close to *S. dorsata* (Cresson) but differs most obviously in having the basal outer ventral tooth of the metafemur large rather than minute.

Description.—Yellow or red with black markings; scrobe cavity usually, occipital area of head, most of mesopraescutum, mesal angles of axillae, anterior margin of mesoscutellum, apices of metacoxae, three spots on outer surface of metafemora, entire propodeum, and sometimes part of gaster, black; darkened area of mesopraescutum usually interrupted so as to produce two anterior squares and a posterior rectangular yellow area.

Female: 5–6.5 mm. Antennal scape short and stout, apex not quite reaching level of ventral margin of anterior ocellus, pedicel one-half, and ring segment one-sixth length of segment 4, segment 5 slightly shorter than 4, segments 5 to 11 equal, 12 and 13 narrower and shorter; scrobe cavity deep, marginal carina vague ventrad; interantennal projection provided with a conspicuous anterior lamina; lateral carinae of frons extending from near frontogenal suture to level of anterior ocellus; frons scatteringly punctured except on mesal area ventrad of antennal bases; frontal tentorial pits located near anterior margins of compound eyes and slightly ventrad of level of antennal bases; malar space one-fourth height of compound eye; frontogenal suture slightly curved, extending transversely from compound eye to dorsal articulation of mandible; combined widths of compound eyes slightly greater than width of interocular space at level of antennal bases; diameter of posterior ocellus slightly less than one-half width of interocellar space.

Dorsum of thorax coarsely punctured; anterolateral angles of pronotum strongly carinate, carina of anterior dorsal margin interrupted on meson; parapsidal furrows partly obliterated; prepectus entirely concealed by a hooklike projection of anterolateral angle of the mesoscutum; mesoscutellum bidentate, these projections blunt, slightly converging, and upturned; metepisternum conspicuously punctured, densely setose; metacoxae entirely glabrous, covered by long, fine setae except on outer dorsal side; metafemora (fig. 12, *d*) glabrous, basal outer ventral tooth nearly as long as following teeth, second and third tooth long, narrow, acute, apical tooth blunt; inner tooth wanting; metatibia with apex long, lanceolate, slightly curved.

Propodeum sparsely setose, conspicuously carinate, two prominent lateral projections present on each side, one, long and slender and directed slightly dorsally, located at each posterolateral angle of propodeum, the other smaller, located near point of insertion of petiole, spiracular openings nearly vertical; petiole glabrous, slender, nearly three times as long as wide at widest point, basal lamina wide on ventral side, lacking on dorsal side, a few long, scattered setae present on each lateral margin; gaster usually seven-eighths length of metafemur; abdominal tergites 3 to 7 with long, sparse lateral setae; eighth tergite but sparsely covered with long setae, spiracular openings with anterior margin straight; cerci oval, located near anterior margin of epipygium; apices of ovipositor sheaths provided with long setae.

Male: 4–6.5 mm. Antennal scape broader at apex than base (fig. 8, *k*); malar space one-fourth height of compound eye; combined widths of compound eyes one-fifth greater than interocular space at level of antennal bases; metafemur without an inner tooth; petiole three times as long as wide.

Type locality.—Florida.

Types.—Holotype, female, British Museum. The male was described as *Smicra pulchra* Cresson, from Cuba; types, 1815.1–1815.4, Academy of Natural Sciences of Philadelphia.

Kirby¹¹ synonymized *Smicra pulchra* (Cresson) with *S. transitiva* (Walker), and notes and sketches from Walker's type, kindly furnished by Dr. Ch. Ferrière, leave no doubt that the synonymy is correct.

Host.—*Catopsilia eubule* (Linnaeus) (Lepidoptera, Pieridae).

Distribution.—FLORIDA: Belleair, Mrs. A. T. Slosson, 1 female; Dade City, November 21, 1907, Russell, 1 male; De Funiak Springs, October 17, 1914, 1 male; Gainesville, September 26, 1914, 1 male, 1 female; December 10, 1917, H. L. Dozier, 1 female; Jacksonville, Ashmead, 4 females. GEORGIA: 1 female.

¹¹ Journ. Linn. Soc. London, Zool., vol. 17, p. 66, 1883.

CUBA: 2 males, 2 females (types of *pulchra* Cresson), ex *Catopsilia eubule*; north of Vinales, September 16, 1913, 1 female.

SPILOCHALCIS PHOENICA, new species

FIGURES 8, *l, m*; 12, *e*

This species is intermediate in some respects between *S. exornata* (Cresson) and *S. nigricornis* (Fabricius) but differs from the former in having more than four teeth on the outer ventral margin of the metafemur and from the latter in having two long, slender teeth on the metafemur (fig. 12, *e*) while *S. nigricornis* has all the teeth blunt (fig. 12, *f*). The male of this species differs from all other species in the genus occurring in this area in that the mesal flange of the antennal scape is produced ventrad of the antennal base (fig. 8, *m*) and the frons is excavated to receive this projection.

Description.—Red or yellow with black markings; mesopraescutum with narrow T-shaped mark, mesal margins of lobes of mesoscutum, mesal angles of axillae, mesoscutellum with narrow, longitudinal mark, apices of metacoxae, variable markings at outer ventral margins of metafemora, and apices of ovipositor sheaths, black.

Female: 6.5–7 mm. Apex of antennal scape not quite reaching level of ventral margin of anterior ocellus; pedicel slightly less than one-half length of segment 4; ring segment one-half length of pedicel, flagellum slightly tapering, segments 4 to 10 equal in length, 11 to 13 slightly shorter, sutures rather indistinct; scrobe cavity moderately deep, marginal carina vague except ventrad; interantennal projection provided with a wide, thin apical lamina; lateral carinae almost completely encircling compound eyes, somewhat indistinct on ventral half; frons scatteringly punctured on area surrounding scrobe cavity, lightly shagreened ventrad of level of antennal bases; frontal tentorial pits at anterior margins of compound eyes and slightly ventrad of level of antennal bases; width of malar space one-quarter height of compound eye; frontogenal suture extending transversely from compound eye to dorsal articulation of mandible; combined widths of compound eyes slightly greater than width of frons at level of antennal bases; diameter of posterior ocellus slightly greater than one-half interocellar space.

Dorsum of thorax densely and deeply pitted, areas between pits minutely reticulated; anterolateral angles of pronotum strongly carinate, anterior dorsal carina interrupted on mesal one-fifth; parapsidal sutures partly obscured; prepectus usually entirely concealed by an anterolateral angle of mesoscutum, occasionally partly exposed, never reaching tegula; mesopleuron with two strongly punctured areas, one dorsad of mesocoxa, other anterior and ventrad of base of posterior wing; apex of mesoscutellum bidentate, these

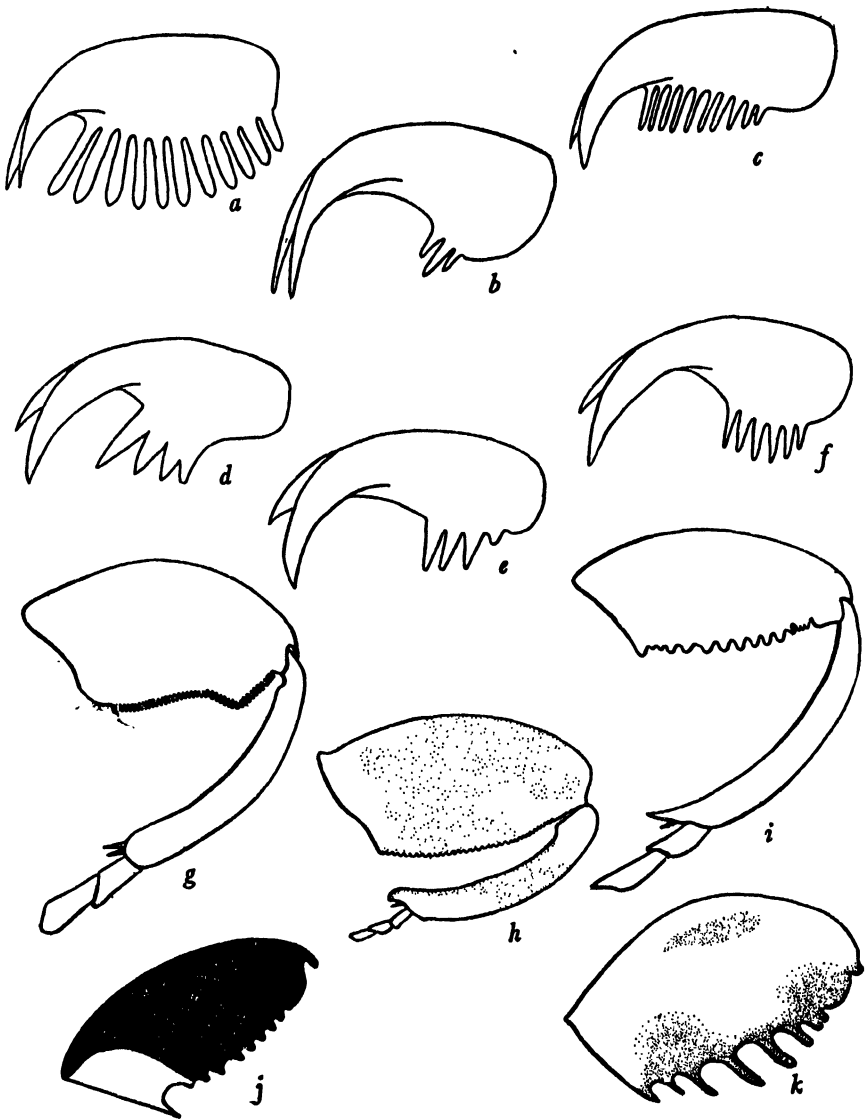


FIGURE 11.—Protarsal claws and metafemora, lateral aspect, of Chalcidini

- a*, *Chalcis lasia*, new species: Protarsal claw.
b, *Chalcis neptis*, new species: Protarsal claw.
c, *Chalcis flebilis* (Cresson): Protarsal claw.
d, *Chalcis barbara* (Cresson): Protarsal claw.
e, *Chalcis canadensis* (Cresson): Protarsal claw.
f, *i*, *Chalcis microgaster* Say: *f*, Protarsal claw; *i*, metafemur and tibia.
g, *Haltichella* sp.: Metafemur and tibia.
h, *Spilochalcis zanthostigma* (Dalman): Metafemur and tibia.
j, *Chalcis megalomis*, new species: Metafemur.
k, *Metadontia amoena* (Say): Metafemur.

projections slightly upturned and transparent, a small carina usually present on dorsal side of each; metepisternum coarsely reticulated, provided with a few very long setae on ventral half; metacoxae semiglobose, glabrous, provided with scattered long setae except on outer dorsal side; metafemora (fig. 12, *e*) glabrous, sparsely covered by short pubescence, outer basal ventral tooth small, second tooth smaller than basal one, two following teeth long, narrow, acute, apical tooth subdivided to form two or three small indistinct ones; inner tooth wanting; dorsal margin of metatibia sinuate where it closes against two long femoral teeth; apex of metatibia long, sharp, slightly curved dorsad.

Propodeum with numerous distinct carinae, those near base and on disk arranged so as to form a double row of rectangles across disk, a pair of conspicuous lateral projections present at posterolateral angles of propodeum, spiracular openings almost vertical; petiole short, glabrous, basal lamina wide on ventral side, slightly narrower on dorsal side, lateral carinae lacking; a few long lateral setae present near apex of petiole; gaster slightly longer than metafemur; lateral setae present on abdominal tergites 3 to 7; eighth tergite glabrous, sparsely provided with short black or yellow setae, spiracular openings round; cercus small, round, located slightly nearer anterior than posterior margin of epipygium, a small tuft of long setae ventrad of each cercus; apex of ovipositor sheaths with long ventral and lateral setae.

Male: 5-5.5 mm. Antennal scape with mesal lamina produced ventrad of antennal base (fig. 8, *l, m*); width of malar space slightly less than one-third height of compound eye; combined widths of compound eyes greater by one-third than width of interocular space at level of antennal bases; metafemur without an inner tooth.

Type locality.—Texas.

Types.—Holotype, female, Victoria, Tex., July 15, 1918, ex *Chlosyne lacinia crocale*, J. D. Mitchell; allotype, male, Devils River, Tex., May 2, 1907, F. C. Pratt; paratypes, E. H. Gibson, 1 female, Port Lavaca, Tex., July 15, 1925, 1 female, Brownsville, Tex., Esprza Ranch, August 18, 2 males. Holotype, allotype, and one female and two male paratypes deposited in the U. S. National Museum; one female paratype in Kansas Agricultural College, Manhattan, Kans.

Host.—*Chlosyne lacinia crocale* Edwards (Lepidoptera, Nymphalidae).

The nigricornis Group

The *nigricornis* group is clearly related to the *transitiva* group through the species *S. nigricornis* (see fig. 12, *f*, for the metafemur of this species). This predominantly tropical group is related to the *femorata* group through the species *S. cowalis* (Cresson). The pos-

session of numerous small metafemoral teeth, the long antennal scape, and the wide and deep scrobe cavity in *S. coxalis* suggest a close relationship with such species as *S. femorata* (Fabricius) and *S. mariae* (Riley). The members of the *nigricornis* group also show some slight relationship with the species of *Chalcis*. The somewhat transverse head of the species of this group and the rather slender metacoxae suggest an affinity with species such as *Chalcis barbara* (Cresson) or *C. microgaster* Say.

The species of the *nigricornis* group are invariably large, deeply and coarsely punctured, and covered with conspicuous long hair over most of the body. The lateral carinae of the frons are lacking; the scrobe cavity is only moderately deep, and the lateral margins are only partly carinate; the abdomen is strongly compressed laterally. The species of this group are all rare, and those that have been reared have come from the pupae of moths of the family Limacodidae.

KEY TO SPECIES OF THE NIGRICORNIS GROUP

1. Hindwings with five or six hamuli (fig. 10, *i*); inner tooth of metafemur present----- 2
- Hindwings with three hamuli (fig. 10, *j*); inner tooth of metafemur lacking----- 3
2. Anterior tentorial pits not connected on meson by a groove; metafemur yellow with black markings (fig. 12, *f*)---- *nigricornis* (p. 279)
- Anterior tentorial pits connected on meson by a deep groove; metafemur entirely black----- *lanieri* (p. 283)
3. Left mandible with three teeth; outer surface of metafemur with an oblique basal stripe----- *coxalis* (p. 284)
- Left mandible with two teeth; outer surface of metafemur not with an oblique basal stripe----- 4
4. Outer basal tooth of metafemur long, slender, acute, much longer than any following teeth (as in fig. 12, *i*), metafemur yellow at base----- *flammeola* (p. 286)
- Outer basal tooth of metafemur no larger than following teeth, metafemur black at base----- *nortoni* (p. 287)

SPILOCHALCIS NIGRICORNIS (Fabricius)

FIGURES 8, *n*; 10, *i*; 12, *f*; 13, *a*

- Chalcis nigricornis* FABRICIUS, Entomologiae systematicae, suppl., p. 243, 1798; Systema piezatorum, p. 163, 1804.—JURINE, Nouvelle méthode de classer les hyménoptères et les diptères, p. 316, 1807.—CRESSON, Proc. Ent. Soc. Philadelphia, vol. 1, p. 228, 1862.
- Smicra nigricornis* (Fabricius) WALKER, Notes on Chalcididae, p. 51, 1871.—CRESSON, Trans. Amer. Ent. Soc., vol. 4, p. 57, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 35, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 234, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 380, 1898.
- Spilochalcis nigricornis* (Fabricius) ASHMEAD, Mem. Carnegie Mus., vol. 1, p. 419, 1904.

- Metadontia nigricornis* (Fabricius) ASHMEAD, *ibid.* p. 453.
- Chalcis braccata* SANBORN, Rept. Secy. Massachusetts Board Agr. for 1862, p. 172, 1863.—PACKARD, Guide to the study of insects . . . , p. 203, 1889.
- Smicra braccata* (Sanborn) CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 37, 46, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 33, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—SMITH, Geol. Surv. New Jersey, Catalogue of insects, p. 37, 1890.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 374, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 34, 1909.
- Spilochalcis braccata* (Sanborn) VIERECK, Connecticut Geol. and Nat. Hist. Surv. Bull. 22, p. 527, 1916.
- Spilochalcis braccata* SMITH, Ann. Rept. New Jersey State Board Agr., vol. 27, suppl., p. 553, 1900; Ann. Rept. New Jersey State Mus. for 1909, p. 649, 1910.
- Smicra braccata coequalis* CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 37, 46, 1872; Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 374, 1898.—CRESSON, The Cresson types of Hymenoptera, p. 74, 1916.
- Smicra carolina* ASHMEAD, Trans. Amer. Ent. Soc., vol. 14, p. 183, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 374, 1898.
- Diplodonita carolina* (Ashmead) ASHMEAD, Mem. Carnegie Mus., vol. 1, p. 252, 1904.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 46, 1909.—GAHAN and FAGAN, U. S. Nat. Mus. Bull. 124, p. 47, 1923.
- Diplodonita secunda* GIRAULT, Descriptiones hymenopterorum chalcidoidicarum variorum cum observationibus, No. 5, p. 10, 1917.—LEONARD, Cornell Univ. Agr. Exp. Stat. Mem. 101, p. 976, 1928.
- Smicra maculata* WALKER (not Fabricius), Entomologist, vol. 1, p. 217, 1841.
- Chalcis maculata* (Walker) CRESSON, Proc. Ent. Soc. Philadelphia, vol. 1, p. 228, 1862.
- Smicra maculata* (Walker) WALKER, Notes on Chalcidae, p. 51, 1871.—CRESSON, Trans. Amer. Ent. Soc., vol. 4, p. 57, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 35, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 223, 1887.—SMITH, Geol. Surv. New Jersey, Catalogue of insects, p. 38, 1890.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 378, 1898.—SMITH, Ann. Rept. New Jersey State Board Agr., vol. 27, suppl., p. 554, 1900; Ann. Rept. New Jersey State Mus. for 1909, p. 649, 1910.

This large yellow and black species is most easily recognized by its densely pubescent propodeum with a pair of conspicuous lateral projections, the acute anterodorsal angles of the pronotum, and the metafemur having a few blunt, widely spaced teeth.

Description.—Yellow with black marks; vertex, all of mesopraescutum except lateral margins, mesal half or two-thirds of lobes of mesoscutum, mesal angles of axillae, mesal longitudinal mark on mesoscutellum, usually ventral half of metepisternum, all but outer basal part of metacoxae, central and ventral spots on metafemur, most or all of propodeum, petiole usually, and most of abdomen, black.

Female: 6-9 mm. Antennal scape stout, curved mesad near base, slightly constricted near apex, apex reaching to level of dorsal margin

of anterior ocellus, pedicel one-half and ring segment one-sixth length of segment 4, segments 4 to 8 equal in length, 9 and 10 slightly shorter, 11, 12, and 13 much shorter than 8; scrobe cavity deep, inner surface minutely shagreened, margins acarinate laterad; interantennal projection with small apical lamina; frons densely punctured on area laterad of scrobe cavity, scatteringly punctured and with short transverse carinae ventrad of antennal bases; frontal tentorial pits not visible; frons without lateral carinae; width of malar space slightly more than one-third height of compound eye; frontogenal suture extending in a low arc from compound eye to mandible, a secondary carina often present dorsad of suture near mandible; combined widths of compound eyes one-tenth less than interocular width at level of antennal bases; left mandible with two indistinct teeth, rarely with three, the ventral one slightly smaller and more acute, right mandible usually with three teeth, occasionally with only two; diameter of posterior ocellus slightly more than one-half interocellar width.

Dorsum of thorax covered by large deep punctures, spaces between pits minutely reticulated, pubescence fine and long; anterior margins of pronotum strongly carinate laterad, anterolateral angles produced, toothlike, mesal one-third of anterior dorsal margin without a carina; mesoscutum slightly produced laterad over tegulae; prepectus visible as a narrow tongue-like projection, not quite reaching tegula; mesoscutellum with a slight mesal depression near base and with a narrow, indistinct, apical lamina; metanotum with an irregular row of long, slender setae; dorsal and anterior areas of metepisternum deeply pitted, areas between pits and unpunctured areas glabrous; metacoxa glabrous, setose except on outer dorsal side; metafemur (fig. 12, *f*) glabrous, densely covered with short setae on outer surface, outer basal tooth small, followed by one, two, or three smaller teeth, then two or three large blunt teeth, apical tooth slightly smaller and more blunt, indistinctly subdivided to form three or four teeth; sharp inner tooth present; dorsal margin of metatibia sinuate where it fits against larger teeth.

Propodeum completely covered by long setae, one large lateral tooth present on each side (fig. 13, *a*), carinae of propodeum strong, irregular, spiracular openings vertical or slanting slightly laterad; petiole short, stout, less than twice as long as wide, surface glabrous, basal lamina wide on ventral side, narrow on dorsum, interrupted at laterodorsal angles, indistinct lateral carinae usually present near base; gaster slightly shorter than metafemur, strongly flattened, abdominal segments 3 to 7 with a few dorsal and lateral setae, eighth tergite glabrous or minutely pitted, sparsely setose, spiracular openings with anterior margins straight; cerci round or nearly so, located

slightly nearer anterior than posterior margin of epipygium, placed in an indistinct setose area, which is bounded mesad and cephalad by a vague carina; apex of ovipositor sheath provided with moderately long ventral setae.

Male: 5.5–8.5 mm. Antennal scape (fig. 8, *n*) expanded near base; combined widths of compound eyes equal to interocular width at level of antennal bases; metafemur with a blunt inner tooth; petiole twice as long as wide.

Type locality.—"North America."

Type.—Chalcis No. 13, Fabricius collection, University of Kiel, Kiel, Germany. Type much broken, moldy; sex not discernible. Specimens compared with this type by Dr. Olaw Schroeder. Synonyms: *bracata* Sanborn, Boston Society of Natural History (comparisons made by Dr. Richard Dow); *bracata coaequalis* Cresson, 1788, Academy of Natural Sciences of Philadelphia; *carolina* Ashmead, 41181, U. S. National Museum; *secunda* Girault, 20750, U. S. National Museum.

This large, conspicuous species is so variable that it is not surprising that it has been described several times. The type of *S. carolina* Ashmead is somewhat broken but shows no differences in either color or structure from specimens compared with the type of *C. nigricornis*. Dr. Richard Dow, of the Boston Society of Natural History, informs me that the type of *C. bracata* Sanborn lacks the abdomen but is identical with the specimens of *nigricornis* sent. The type of *D. secunda* Girault is considerably broken, but the remains show no valid departure from the typical *nigricornis*. All the references to *maculata* enumerated above were derived from Walker's record of what he supposed to be *maculata* Fabricius from New York. Dr. Ch. Ferrière, of the British Museum, has kindly located Walker's specimen for me, and he states that this specimen, although somewhat broken, can be identified as *nigricornis*. *Chalcis maculata* Fabricius was described from South America, and Ashmead¹² placed it in his genus *Tetrasmicra*; it is possible that he had seen the type.

Hosts.—*Parasa indetermina* Boisduval, *Adoneta spinuloides* Herrich-Schaeffer, *Limacodes* sp. (Lepidoptera, Limacodidae).

Distribution.—Connecticut, Illinois, Indiana, Louisiana, Maryland, Massachusetts, Nebraska, New Hampshire, New Jersey, New York, North Dakota, North Carolina, South Carolina, South Dakota, Texas, Virginia.

¹² Mem. Carnegie Mus., vol. 1, p. 456, 1904.

SPILOCHALCIS LANIERI (Guérin)

FIGURE 12, *g*

- Chalcis lasnerti* GUÉRIN, Iconographie du Règne animal de G. Cuvier . . . , vol. 1, p. 412, 1845.—CRESSON, Proc. Ent. Soc. Philadelphia, vol. 1, p. 228, 1862.
- Chalcis lanieri* GUÉRIN, in de la Sagra's Historia física, política y natural de la isla de Cuba, vol. 7, p. 735, 1857.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 36, 1885.
- Smicra lanieri* (Guérin) CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 91, 1865.—WALKER, Notes on Chalcididae, p. 51, 1871.—CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 37, 48, 1878.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 378, 1898.—ASHMEAD, Trans. Ent. Soc. London, vol. 48, p. 337, 1900.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 35, 1909.
- Spilochalcis lanieri* (Guérin) GAHAN, Mem. Soc. Poey, Univ. Habana, vol. 8, p. 131, 1934.

This species may be recognized at once by its dark brown wings, which retain a quite complete representation of the venation, and the entirely black metafemora. Structurally this species is almost identical with *Spilochalcis nigricornis* (Fabricius).

Description.—Black, with bright scarlet markings; forelegs and mesolegs, mandibles, narrow stripe surrounding compound eyes, mesodorsal area and anterolateral margins of pronotum, lateral margins of mesopraescutum, entire mesoscutellum, metatibia, and basal segments of gaster, scarlet.

Female: 8 mm. Apex of antennal scape not quite reaching level of dorsal margin of anterior ocellus, pedicel one-fourth and ring segment one-sixth length of segment 4, segments 4 to 8 equal in length, 9 to 10 slightly shorter, last three combined slightly longer than segment 4; width of malar space one-third height of compound eye; frontogenal suture slightly curved; left mandible with two teeth, right with three; combined widths of compound eyes slightly less than width of interocular space at level of antennal bases; diameter of posterior ocellus five-ninths interocellar space; a carina extending completely around posterior margin of head.

Dorsum of thorax deeply punctured, narrow area at anterior margin of metepisternum not punctured, but minutely reticulated; setae long, coarse; anterolateral angles of pronotum acutely produced, toothlike, carina of anterior dorsal margin interrupted on mesal one-half; prepectus not quite reaching tegula; hind wings with five hamuli; mesoscutellum with a slight longitudinal mesal depression near base, apex with a minute lamina; metepisternum not punctured at posterior margin, ventral margin provided with a row of large, contiguous punctures, rest of area covered with smaller punctures, spaces between them glabrous; metacoxae glabrous; metafemora glabrous, outer surface sparsely covered by long setae, teeth of ventral margin quite variable: one to four minute basal teeth, followed by

three larger ones (fig. 12, *g*), apical one vaguely divided; inner tooth large, acute.

Propodeum with a pair of large lateral teeth (as in fig. 13, *a*), spiracular openings vertical; petiole glabrous, two and one-quarter times as long as wide, lateral carinae wanting; gaster strongly flattened, all segments of gaster with sparse lateral setae; spiracular opening of eighth tergite rounded, but anterior margin straight; cerci oval, located near anterior margin of epipygium; ovipositor sheaths densely covered with short, stiff setae.

Male.—Unknown.

Type locality.—Cuba.

Type.—I have not located the type of this species, and it may be lost. As this type may, however, yet be found, it seems best not to designate a neotype. I have followed Cresson's determination¹³ for the species.

Host.—Unknown.

Distribution.—FLORIDA: Palm Beach, C. F. Baker, 1 female.

CUBA: 2 females.

SPILOCHALCIS COXALIS (Cresson)

Smicra coxalis CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 36, 45, 1872.—

HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 34, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 375, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 34, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 74, 1916.

Spilochalcis virens HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, pp. 6, 36, 1885.—

DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 385, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 41, 1909.

Smicra virens (Howard) CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 234, 1887.

This large, compact species is most easily recognized by the densely pubescent propodeum without lateral teeth, the compressed abdomen, and the metafemora with the ventral margin provided with several minute, widely spaced teeth; both mandibles have three teeth.

Description.—Yellow or red with black markings; vertex, all but lateral margins of mesopraescutum, all but lateral margins of lobes of mesoscutum, mesal two-thirds of axillae, broad longitudinal mark on mesoscutellum, usually wide inner and outer stripes on metacoxae, oblique stripe on outer surface of metafemur near base, transverse band at base of propodeum, most of petiole, and transverse dorsal marks on gaster, black.

Female: 7.5–9 mm. Apex of antennal scape exceeding level of posterior ocelli, pedicel two-fifths and ring segment one-eighth length of segment 4, segments 4 and 5 almost equal, 6 to 10 progressively

¹³ Proc. Ent. Soc. Philadelphia, vol. 1, p. 228, 1862.

shorter, 11 three-quarters length of 10, 12 and 13 considerably shorter than 11 but quite variable in exact size; scrobe cavity rather shallow, edge carinate on ventral margin and ventral one-third of lateral margins; interantennal projection with a narrow, apical lamina; lateral carinae of frons wanting; entire frons deeply and densely punctured, and provided with long setae; frontal tentorial pits located near antennal bases, slightly dorsad of antennal bases; width of malar space slightly more than one-third height of compound eye; frontogenal suture extending in a low arc from compound eye to dorsal articulation of mandible; combined widths of compound eyes two-thirds width of interocular space at level of antennal bases; both mandibles with three teeth; diameter of posterior ocellus slightly less than one-half width of interocellar space.

Dorsum of thorax densely punctured, lateral punctures slightly larger than mesal ones, areas between punctures varying from glabrous to lightly reticulated; pubescence dense, long, fine; anterolateral angles of pronotum only faintly carinate, anterior dorsal margin without a carina on mesal three-quarters, a rounded projection present near each posterior laterodorsal angle of pronotum; parapsidal sutures partly obscured by punctures; prepectus not visible; apex of mesoscutellum provided with a minute lamina; metepisternum broad, shallowly pitted, areas between pits glabrous, sparsely covered by long setae; metacoxae glabrous, very slender near apex, sparsely covered by long pubescence; metafemora glabrous, outer surface covered by short pubescence, ventral margin arcuate, with 12 to 16 minute, blunt, widely spaced teeth; inner tooth lacking; apex of metatibia acute, slightly curved dorsad.

Propodeum densely covered by long, slender setae, carinae strong, but irregular, enclosing nearly quadrangular areas, one very slight lateral tooth present on each side near point of insertion of petiole, spiracular openings large, extending obliquely laterad; petiole glabrous or showing very faint shagreening under a strong light, a prominent lateral furrow extending from base to apex on either side, basal lamina narrow, interrupted at dorsolateral angles; gaster strongly flattened, slightly larger than metafemur, prominent lateral rows of setae present on abdominal tergites 3 to 7; eighth tergite minutely pitted, covered with long, stout setae, spiracular openings round; cerci oval, located near anterior margin of epipygium and usually bearing three long setae; apices of ovipositor sheaths densely covered with long setae.

Male: Unknown.

Type locality.—Delaware.

Types.—Holotype, female, 1787, Academy of Natural Sciences of Philadelphia. Synonym, *virens* Howard, 2623, U. S. National Museum.

The original description of *S. coxalis* Cresson erroneously states that the species is described from a male; the type is a female. The type of *S. virens* Howard differs neither in color nor in structure from the type of *S. coxalis* Cresson.

This species may prove to be a synonym of *Spilochalcis conjungens* (Walker). *Smicra conjungens* was described from a single female specimen from Mexico one year previous to the publication of the description of *Smicra coxalis* Cresson. A specimen I had compared with the type of the latter species was sent to the Muséum National d'Histoire Naturelle in Paris for comparison with Walker's type. Dr. Lucien Berland kindly made a detailed study of the specimens and informed me that they differed slightly in the sculpturing of the propodeum and the shape of the metafemoral teeth. Neither of these characters is, in itself, sufficient for specific distinction in this group. I have, however, decided to use, for the present, the name concerning the correctness of which I have no doubt, rather than employ one that is somewhat questionable.

Host.—Unknown.

Distribution.—Delaware, Georgia, Iowa, Maryland, Missouri, New Jersey, New York, North Carolina, Virginia.

SPILOCHALCIS FLAMMEOLA (Cresson)

Smicra flammeola CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 37, 48, 1872.—CAMERON, Biologia Centrali-Americana, Hymenoptera, vol. 1, p. 84, 1884.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 34, 1885.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 377, 1898.—SCHMEDEKNECHT, Genera Insectorum, fasc. 97, p. 34, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 75, 1916.

Smicra flammula KIRBY, Journ. Linn. Soc. London, Zool., vol. 17, p. 66, 1883.

This species is most easily recognized by its very coarsely pitted thorax, the toothlike anterolateral angles of the pronotum, and the metafemur with a long, acute, outer basal tooth and no inner tooth.

Description.—Bright red, with frons, anterior and mesolegs, dorsal spot at base of outer surface of metafemur, and usually petiole, yellow; venter of thorax black.

Female: 7 mm. Antennal flagellum slender; scrobe cavity shallow, carinate at ventral margin; interantennal projection with a small anterior carina, this carina extending up into scrobe cavity almost to anterior ocellus; frons deeply punctured just ventrad and laterad of ocelli, a few vague carinae extending ventrolaterad from margins of scrobe cavity; frons slightly produced ventrad of antennal bases; frontal tentorial pits located just laterad of and slightly ventrad of antennal bases; width of malar space slightly more than one-third height of compound eye; frontogenal suture straight; widths of compound eyes slightly less than width of interocular space at level of

antennal bases; left mandible with two teeth, ventral one larger, right mandible with three teeth, two dorsal ones blunt, ventral one larger and more acute; diameter of posterior ocellus slightly less than one-half width of interocellar space.

Dorsum of thorax irregularly covered by large, deep punctures, areas between punctures minutely reticulated, pubescence long, fine; anterolateral angles of pronotum acutely projecting, toothlike, anterior dorsal carina interrupted on mesal one-third; parapsidal furrows partly obliterated; prepectus entirely concealed by projecting lateral margin of mesoscutum; apex of mesoscutellum with a rather wide lamina; metepisternum strongly and densely punctured except at posteroventral angle, pubescence sparse and fine; metacoxae glabrous, provided, except on outer dorsal surface, with long setae; outer surface of metafemora glabrous, sparsely covered by long, black setae, basal tooth large, acute, followed by 13 or 14 small acute teeth; inner tooth wanting; apex of metatibia long, slender, acute.

Propodeum provided with long setae at posterolateral angles, surface provided with large, strong carinae, areas between carinae almost glabrous, spiracular openings small, vertical, no lateral projections present on propodeum; petiole glabrous, provided with several long, lateral setae, basal lamina narrow, interrupted at dorsolateral angles; gaster compressed, usually slightly longer than metafemur, abdominal tergites 3 to 7 each with long lateral setae; eighth tergite densely covered by minute pits, setae long, sparse, spiracular openings oval; cerci oval, located midway between anterior and posterior margins of epipygium; apex of ovipositor sheaths provided with dense, short ventral setae.

Male: Unknown.

Type locality.—Mexico.

Types.—Holotype, female, 1811.1; paratypes, 1811.2, 1811.5, 2 females: Academy of Natural Sciences of Philadelphia. The two supposed paratypes of this species labeled 1811.3 and 1811.4, in the collection of the Academy of Natural Sciences of Philadelphia, unquestionably represent another species. The original description of this species states that it was described from both males and females, but all the type specimens are females.

Host.—Unknown.

Distribution.—TEXAS: Brownsville, November 25, 1910, 1 female.

MEXICO: 3 females (holotype and paratypes).

SPILOCHALCIS NORTONI (Cresson)

FIGURES 8, o; 10, j; 13, c

Smicra nortoni CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 36, 45, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 85, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 234,

1887.—DALLA TORRE, *Catalogus hymenopterorum*, vol. 5, p. 380, 1898.—SMITH, *Ann. Rept. New Jersey State Board Agr.*, vol. 27, suppl., p. 554, 1900.—SCHMIEDEKNECHT, *Genera Insectorum*, fasc. 97, p. 36, 1909.—CRESSON, *The Cresson types of Hymenoptera*, p. 76, 1916.

Spilochalcis nortoni (Cresson) SMITH, *Ann. Rept. New Jersey State Mus. for 1909*, p. 649, 1910.—VIERECK, *Connecticut Geol. and Nat. Hist. Surv. Bull.* 22, p. 527, 1916.

This large yellow and black species is most easily recognized by its densely pubescent metanotum and propodeum, the latter without lateral teeth; the left mandible has two teeth and the right three indistinct ones.

Description.—Yellow with black markings; vertex, all but lateral margins of mesopraescutum and mesoscutum, mesal two-thirds of axillae, mesal longitudinal mark on mesoscutellum, broad outer and inner basal stripes of metacoxae, irregular area at base of metafemora, transverse basal stripe on propodeum, and transverse dorsal bands on gaster, black.

Female: 9–11 mm. Antennal scape constricted just ventrad of apex, reaching level of posterior ocelli, pedicel slightly less than one-half and ring segment one-sixth length of segment 4, segments 4 to 9 equal in length, 10 slightly shorter, 11 two-thirds length of 10, 12 and 13 together slightly longer than 11; scrobe cavity deep, edge carinate only at ventral margin and ventral one-fourth of lateral margins, inter-antennal projection wide, without an apical lamina; frons without lateral carinae; frons deeply and densely punctured except on small patch just dorsal to clypeus; frontal tentorial pits not visible; width of malar space slightly less than one-third height of compound eye; frontogenal suture extending in a low arc from compound eye to dorsal articulation of mandible; width of interocular space at level of antennal bases greater by one-fifth than combined widths of com-

FIGURE 12.—Metafemora, lateral aspect, of Chalcidini

- a, *Spilochalcis exornata* (Cresson).
- b, *Spilochalcis eubule* (Cresson).
- c, *Spilochalcis dorsata* (Cresson).
- d, *Spilochalcis transitiva* (Walker).
- e, *Spilochalcis phoenica*, new species.
- f, *Spilochalcis nigricornis* (Fabricius).
- g, *Spilochalcis lanieri* (Guérin).
- h, *Spilochalcis delicata* (Cresson).
- i, *Spilochalcis femorata* (Fabricius).
- j, *Spilochalcis mariae* (Riley).
- k, *Spilochalcis subobsolata* (Cresson).
- l, *Ceratismicra paya*, new species.
- m, *Ceratismicra debilis* (Say).
- n, *Ceratismicra immaculata* (Cresson).
- o, *Ceratismicra meteori*, new name.

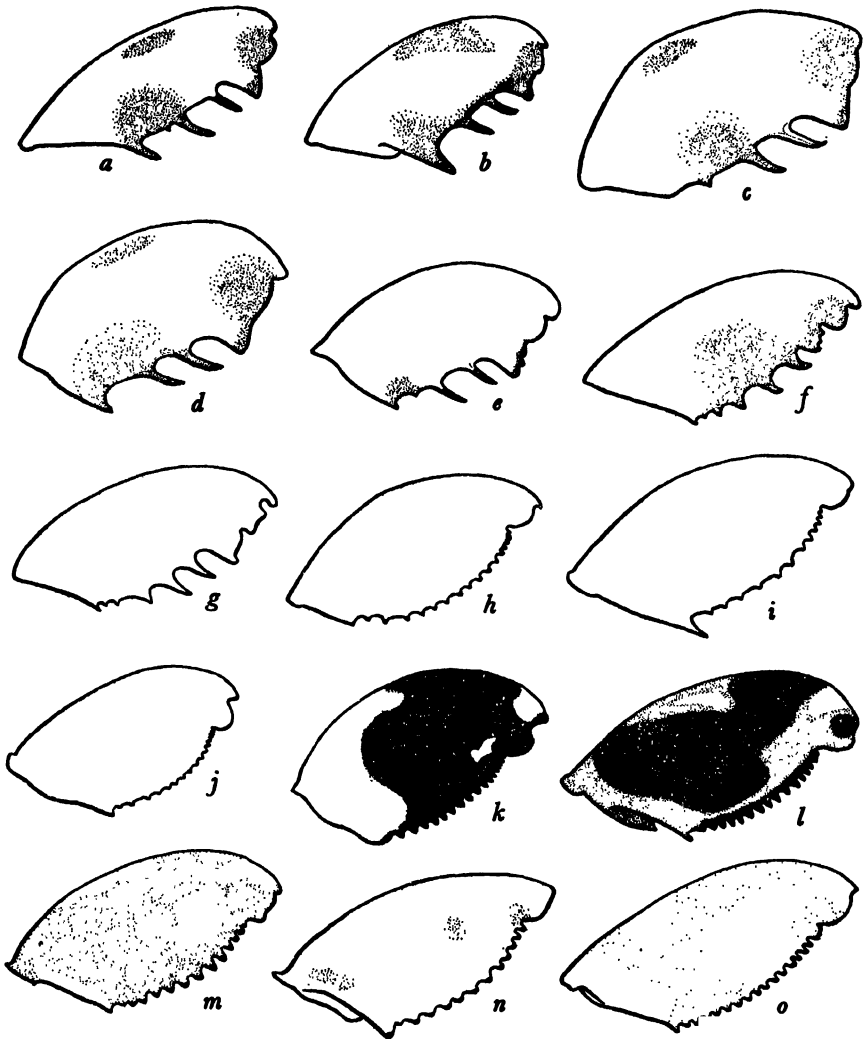


FIGURE 12.—See opposite page for explanation.

pound eyes; left mandible with two teeth, right with three, the two ventral ones indistinctly divided; diameter of posterior ocellus two-fifths width of interocellar space.

Dorsum of thorax covered with large punctures, spaces between punctures minutely reticulated; pubescence long, fine; anterolateral angles of pronotum carinate; anterior dorsal margin of pronotum acarinate on mesal one-quarter; parapsidal furrows distinct; the surface of mesopraescutum slightly higher than surface of mesoscutum; prepectus narrow, tonguelike, not quite reaching tegula; anterior margin of mesoscutellum with a minute mesal projection, apex with a minute lamina; metepisternum covered with deep, nearly contiguous pits; metacoxae relatively slender, surface almost glabrous, reticulations extremely faint; metafemora glabrous, outer surface densely covered by short pubescence, outer ventral margin with 11 to 18 small blunt teeth; inner tooth lacking; basal enlargement of posterior claw with several large teeth.

Propodeum densely covered by long setae; reticulations prominent, rather irregular, enclosing large, nearly rectangular areas near apex; strong lateral projections wanting (fig. 13, *c*), spiracular openings wide, almost vertical; petiole glabrous, short, less than twice as long as wide, basal lamina narrow on ventral side, slightly wider on dorsal side, interrupted at dorsolateral angles, faint longitudinal, lateral grooves present; gaster strongly compressed, slightly larger than metafemur; abdominal tergites 3 to 7 with rows of short lateral setae; eighth tergite minutely punctured, densely covered by long pubescence, spiracular openings with anterior margins straight; epipygium densely pubescent, cerci oval, located near anterior margin and provided with four or five long setae; apices of ovipositor sheaths with long, dense setae.

Male: 7.5 mm. Antennal scape (fig. 8, *o*) broad, slightly expanded at apex; width of malar space one-quarter height of compound eye; petiole twice as long as wide.

Type locality.—District of Columbia.

Type.—Neotype, male, Bolton, Conn., July 20, 1932, ex *Phobetron pithecium*; deposited in the U. S. National Museum. This species was originally described from a single male specimen collected by Edward Norton in Washington, D. C., and the type has subsequently been lost. A neotype is, therefore, designated.

Hosts.—*Prolimacodes badia* (Hübner), *Phobetron pithecium* Abbot and Smith (Lepidoptera, Limacodidae).

Distribution.—Connecticut, District of Columbia, Illinois, Massachusetts, New Jersey, New York, Texas, Virginia.

The femorata Group

The *femorata* group is predominantly tropical but includes one very common species in our region, *S. mariae* (Riley). In all species of this group the antennal scape is long, and the flagellum is usually slender. The scrobe cavity is either deep or shallow; the frons is always slightly produced anteriorly just ventrad of the antennal bases. All the species of this group have the metafemoral teeth minute and closely set, but the basal tooth is often considerably larger than the following ones; all species are yellow or red with relatively small darker markings.

KEY TO SPECIES OF THE FEMORATA GROUP

1. Female, ninth abdominal sternite concealed, antennal scape slender..... 2
 Male, ninth abdominal sternite exposed, antennal scape broad..... 8
2. Head, from dorsal aspect, one-half as long as wide, apex of antennal scape reaching only to level of posterior ocelli..... 3
 Head transverse, from dorsal aspect much less than one-half as long as wide; apex of antennal scape markedly exceeding level of posterior ocelli..... 5
3. Metepisternum entirely glabrous, stigmal vein of forewing rounded at apex (fig. 10, *h*)..... *delicata* (p. 292)
 Metepisternum punctured, stigmal vein of forewing angled at apex (fig. 10, *k*)..... 4
4. Width of head much greater than maximum width of dorsum of thorax; spiracular openings on propodeum wider dorsad than ventrad..... *elachis* (p. 294)
 Width of head equal to maximum width of dorsum of thorax; spiracular openings on propodeum equal in width dorsad and ventrad..... *hirtifemora* (p. 295)
5. Surface of mesopraescutum and scutum provided only with punctures..... *femorata* (p. 297)
 Surface of mesopraescutum and scutum provided both with punctures and carinae, the carinae on mesopraescutum transverse, those on lobes of mesoscutum directed obliquely cephalad from posteromesal angles..... 6
6. Metafemur with a small inner tooth; a brown spot surrounding stigmal vein; mesopraescutum always with a median black line, this line usually broader at anterior than at posterior margin; anterior lamina of pronotum slightly incised near dorsolateral angle..... *igneoides* (p. 301)
 Not having that combination of characters..... 7
7. Strong lateral carinae present on petiole, and venter of petiole usually slightly rugose; metacoxae always with a black stripe on outer dorsal surface extending almost from base to apex.
 *mariae* (p. 303)
 Petiole either without lateral carinae or with faint ones near base, and venter of petiole smooth; metacoxae with a dark spot on outer dorsal surface, this spot not reaching apex of coxa..... *phais* (p. 307)

8. Metepisternum entirely glabrous, stigmal vein of forewing rounded at apex (fig. 10, *h*)----- *delicata* (p. 292)
 Metepisternum punctured, stigmal vein of forewing angled at apex (fig. 10, *k*)----- 9
9. Apex of antennal scape reaching only to level of posterior ocelli; head, from dorsal aspect, one-half as long as wide--- *hirtifemora* (p. 295)
 Apex of antennal scape markedly exceeding level of posterior ocelli; head, from dorsal aspect, much less than one-half as long as wide----- 10
10. Surfaces of mesopraescutum and scutum provided only with punctures----- *femorata* (p. 297)
 Surfaces of mesopraescutum and scutum provided both with punctures and carinae, the carinae on mesopraescutum transverse, those on lobes of mesoscutum directed obliquely cephalad from posteromesal angles----- 11
11. Pedicel of antenna triangular (fig. 9, *u*)----- *mariae*, (p. 303)
 Pedicel of antenna cylindrical (fig. 9, *t*)----- 12
12. Anterior mesal margin of antennal scape strongly incised (fig. 8, *s*)----- *igneoides* (p. 301)
 Anterior mesal margin of antennal scape not incised (fig. 9, *a*, *b*)----- 13
13. Antennal scape broadened only at apex, slightly excavated at apex (fig. 9, *a*)----- *clora* (p. 306)
 Antennal scape broad from near base to apex, deeply excavated at apex (fig. 9, *b*)----- *phais* (p. 307)

SPILOCHALCIS DELICATA (Cresson)

FIGURES 8, *p*; 10, *h*; 12, *h*; 13, *b*

Smicra delicata CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 38, 54, 192, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 34, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 375, 1898.—SCHMIEDEKNECHT, Genera Insectorum, fasc. 97, p. 34, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 74, 1916.
Smicra delicatula CAMERON, Biologia Centrali-Americana, Hymenoptera, vol. 1, p. 94, 1884.

This small yellow species is most easily recognized by its very wide interocular space, the shallow scrobe cavity, the broad, compact thorax with the dorsal surface nearly glabrous, the rather long, slender petiole, and slender metafemora with a large, acute inner tooth; the apex of the antennal scape of the male markedly exceeds the level of the posterior ocelli but only reaches this level in the female.

Description.—Yellow, with vague, variable orange or light-brown markings; occiput, broad mesal area of mesopraescutum, most of lobes of mesoscutum, mesal angles of axillae, apex of mesoscutellum, spot on mesopleuron, basal mark on outer dorsal surface of metacoxa, and apical segment of posterior tarsus, usually orange or light brown; metafemoral teeth and, in some specimens, basal segments of gaster, black.

Female: 3.5 mm. Apex of antennal scape reaching level of posterior ocelli, pedicel much narrower than flagellar segments, two-thirds length of segment 4, ring segment one-half length of pedicel, segment 5 slightly shorter than 4, segments 5 to 11 equal in length, 12 and 13 slightly shorter; scrobe cavity shallow, margin carinate only at ventrolateral angles; apical carina of interantennal projection extended dorsad one-half distance to anterior ocellus; frontal tentorial pits minute, located near margin of compound eye, and ventrad of antennal bases; frons almost glabrous, with minute slightly irregular carinae, these carinae transverse on area of frons ventrad of antennal bases, pubescence long, sparse; small mesal area located just dorsad of clypeus more closely reticulated than remainder of frons; width of malar space one-third height of compound eye; frontogenal suture almost straight, very slightly curved; a vague carina usually present on genal area parallel to posterior margin of compound eye; combined widths of compound eyes two-thirds width of interocular space at level of antennal bases; left mandible with two teeth, ventral one much longer than dorsal, right mandible with three teeth, middle one minute; diameter of posterior ocellus one-third interocellar space.

Dorsum of thorax minutely reticulated, almost glabrous, a few vague, shallow punctures present, pubescence long, sparse; anterolateral angles and anterior dorsal margin of pronotum acarinate, prepectus wider than in most species, just reaching anterior apex of tegula; stigmal knob of forewing large, rounded (fig. 10, *h*); apex of mesoscutellum with an extremely narrow lamina; metepisternum glabrous; metacoxae glabrous on outer dorsal surface, sparsely covered with short setae on ventral side; metafemora rather narrow (fig. 12, *h*), outer ventral margin provided with 14 to 20 small, acute teeth, these teeth often widely spaced; inner tooth large, acute.

Propodeum with a single mesal and lateral carina, basolateral areas minutely reticulated, almost smooth, spiracular openings slanting laterad (fig. 13, *b*), no lateral propodeal teeth present; petiole glabrous, twice as long as wide, basal lamina wide on ventral side, narrow on dorsal; gaster usually equal in length to metafemur, abdominal tergites 4 to 7 each with a single sparse lateral row of long setae; eighth tergite slightly shagreened, provided with a few slender, inconspicuous setae, spiracular openings round; cerci large, oval, located near posterior margin of epipygium; apex of ovipositor sheath with a few long ventral setae.

Male: 3.5–4 mm. This species exhibits greater antigeny than most other species of the genus. Antennal scape (fig. 8, *p*) with apex markedly exceeding level of posterior ocelli, antennal segments 5 to 10 usually equal, last three slightly shorter; width of malar space three-tenths height of compound eye; combined widths of compound

eyes four-fifths interocular space; diameter of posterior ocellus three-sevenths interocellar space; petiole three times as long as wide.

Type locality.—Texas.

Types.—Holotype, female, 1794, Academy of Natural Sciences of Philadelphia; allotype, male, 1654, U. S. National Museum.

Host.—Unknown.

Distribution.—FLORIDA: Jacksonville, 1 male. TEXAS: Belfrage, 49, 1 female, 1 male (holotype and allotype); Brownsville, November 23–December 1, 1910, 3 males; Cameron County, August 3, 1928, R. H. Beamer, 1 female; Corpus Christi, October 16, 1908, Mitchell and Bishopp, 1 male.

SPILOCHALCIS ELACHIS, new species

This species is closely related to *S. hirtifemora* (Ashmead) but differs in having the head wider in comparison to the thorax, the propodeum very weakly carinate, with the areas between carinae reticulated rather than glabrous; the spiracular slits of the propodeum are wider dorsad than ventrad, while these openings are uniform in width in *hirtifemora*.

Description.—Dull yellow or orange; venter of thorax, vague longitudinal stripe on mesopraescutum, and most of abdomen, light brown.

Female: 2–2.5 mm. Apex of antennal scape reaching level of dorsal margin of anterior ocellus, pedicel equal to and ring segment one-quarter length of segment 4, segment 5 slightly shorter than 4, 6 slightly longer than 5, 6 to 10 equal, 11 slightly shorter, 12 slightly longer than 10, 13 as long as 11; scrobe cavity shallow, only ventral margin carinate; interantennal projection with a minute anterior carina; frons minutely reticulated laterad of scrobe cavity, scatteringly punctured just anterior to posterior ocelli and ventrad of antennal bases; frontal tentorial pits not visible; width of malar space one-third height of compound eye; frontogenal suture slightly curved, almost straight; combined widths of compound eyes equal to interocular space at level of antennal bases; left mandible with two acute teeth, ventral one slightly larger; diameter of posterior ocellus slightly less than one-half interocellar space; width of head one-fourth greater than maximum dorsal width of thorax.

Dorsum of thorax densely covered by irregular, shallow punctures, pubescence short, sparse; anterolateral angles of pronotum obscurely carinate, anterior dorsal margin acarinate; parapsidal furrows distinct; prepectus not visible, completely hidden by anterolateral angles of mesoscutum; apex of mesoscutellum with a very narrow, mesally depressed lamina; metacoxae with a few large, indistinct ventral punctures, remainder of surface minutely shagreened; outer surface

of metafemora minutely shagreened, almost glabrous, ventral margin with 18 to 20 small closely set teeth, basal one slightly larger; inner tooth sharp.

Propodeum with a few long lateral setae, strong carinae present near apex and on meson, two minutely reticulated areas at base, spiracular slits almost vertical, wider dorsad than ventrad, propodeum without lateral projections; petiole three times as long as wide, surface minutely reticulated, basal lamina narrow, lateral carinae absent; gaster acuminate, slightly longer than metafemur, abdominal tergites 5 to 7 with sparse lateral setae; eighth tergite obscurely shagreened, almost glabrous, setae sparse, short, spiracular openings round, directed laterad; cerci obovate, located slightly nearer anterior than posterior margin of epipygium, the latter densely and minutely pitted and provided with long setae; apex of ovipositor sheath with a few short ventral setae.

Male.—Unknown.

Type locality.—Florida.

Types.—Holotype, female, Biscayne Bay, Fla.; paratype, Tallulah, La., 1194, 1 female. Types deposited in the U. S. National Museum.

Host.—Unknown; this species will probably prove to be a hyperparasite.

SPILOCHALCIS HIRTIFEMORA (Ashmead)

FIGURE 8, *q*

Smicra hirtifemora ASHMEAD, Trans. Amer. Ent. Soc., vol. 12, p. x, 1885.—

CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 377, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 35, 1909.

Spilochalcis hirtifemora (Ashmead) WILSON, Florida Ent., vol. 16, p. 39, 1932; vol. 17, p. 3, 1933; Florida Agr. Exp. Stat. Techn. Bull. 271, p. 16, 1935.

Spilochalcis syrphidis WOLCOTT, Journ. Dept. Agr. Puerto Rico, vol. 7, p. 57, 1923; Journ. Agr. Univ. Puerto Rico, vol. 20, p. 536, 1936.

This small yellow or orange species is most easily recognized by having the head, from the dorsal aspect, one-half as long as wide, the scrobe cavity shallow, the apex of the antennal scape just reaching the level of the posterior ocelli, and the width of the head equal to the maximum dorsal width of thorax; there is an indistinct spot around the stigmal vein of the forewing. This species bears a superficial resemblance to some members of the genus *Decatoma*.

Description.—Yellowish or orange; venter of thorax, variable longitudinal mesal stripe on mesopraescutum, spot around stigmal vein, and most of abdomen, reddish brown.

Female: 3–4 mm. Apex of antennal scape reaching level of posterior ocelli, pedicel three-quarters and ring segment one-quarter length

of segment 4, segments 4 to 10 usually equal, somewhat variable, 11 and 12 slightly shorter than 10, 13 usually equal to 10; scrobe cavity shallow, carinate at ventral margin and ventral half of lateral margins, the latter strongly curved mesad; interantennal projection with a minute, vague anterior carina; frons minutely reticulated, almost glabrous ventrad of antennal bases, pubescence short, sparse; frontal tentorial pits located ventrad and laterad of antennal bases; width of malar space one-third height of compound eye; frontogenal suture slightly curved; combined widths of compound eyes equal to interocular width at level of antennal bases; left mandible with two acute teeth, dorsal one larger, right mandible with three teeth; diameter of posterior ocellus from slightly more than one-half to three-fifths width of interocellar space; head, from dorsal aspect, one-half as long as wide.

Dorsum of thorax with close irregular punctures, pubescence inconspicuous except at lateral margins of thorax, where it is slightly longer and stouter; anterolateral angles of pronotum minutely carinate; anterior dorsal margin acarinate; parapsidal furrows distinct; prepectus not visible; apex of mesoscutellum with a narrow, mesally depressed lamina; metepisternum covered by large, shallow punctures, pubescence short and fine; metacoxae with entire surface shagreened, setose on outer ventral side, sparsely so on dorsal; metafemora with outer surface minutely reticulated, pubescence short, sparse, ventral margin provided with 16 to 20 small, closely set teeth, basal one slightly larger; inner tooth sharp.

Propodeum usually entirely without setae, surface provided with strong carinae, areas between carinae glabrous, spiracular openings oblique, one very slight projection present at each posterolateral angle of propodeum; petiole two and one-quarter times as long as wide, entire surface shagreened and uneven, basal lamina wide, lateral carinae absent; gaster acuminate, slightly longer than metafemur, abdominal tergites 4 to 7 with long, sparse lateral setae; eighth tergite minutely and obscurely reticulated, setae long, sparse; spiracular openings round; cerci oval, located midway between anterior and posterior margins of epipygium; apex of ovipositor sheaths with a few short ventral setae.

Male: 2.5–3 mm. Antennal scape (fig. 8, *q*) enlarged in the middle; flagellum stout, segments usually as wide as long; width of malar space two-fifths height of compound eye; combined widths of compound eyes slightly less than interocular space at level of antennal bases; petiole four times as long as wide.

Type locality.—Florida.

Types.—Holotype, male, 51949, U. S. National Museum. The female was described as *Spilochalcis syrphidis* Wolcott, from Puerto

Rico; types, 51871, U. S. National Museum, and three specimens in the collection of the Puerto Rico Agricultural Experiment Station collection, Rio Piedras, P. R.

The type of *S. syrphidis* Wolcott differs only in sex from the type of *S. hirtifemora* (Ashmead).

Hosts.—*Mesogramma polita* (Say), *Mesogramma polygonastyla* (Metcalf), *Platychirus* sp. (Diptera, Syrphidae); *Apanteles marginiventris* (Cresson), *Apanteles* sp. (Hymenoptera, Braconidae).

Distribution.—District of Columbia, Florida, Georgia, Illinois, Ohio, Tennessee, Texas.

Cuba, Dominican Republic, Puerto Rico.

SPILOCHALCIS FEMORATA (Fabricius)

FIGURES 7, *f*, *j*; 8, *r*; 12, *i*

Crabro femoratus FABRICIUS, *Systema entomologiae* . . . , p. 375, 1775; *Species insectorum* . . . , vol. 1, p. 472, 1781; *Mantissa insectorum* . . . , vol. 1, p. 297, 1787.—OLIVIER, *Encyclopédie méthodique*, vol. 6, p. 518, 1791.

Vespa femorata (Fabricius) GMELIN, *Systema naturae*, ed. 13, vol. 1, p. 2765, 1790.

Smicra femorata (Fabricius) KIRBY, *Journ. Linn. Soc. London, Zool.*, vol. 17, p. 86, 1883.

Spilochalcis femorata (Fabricius) HOWARD, *Journ. Linn. Soc. London, Zool.*, vol. 25, p. 79, 1894; vol. 26, p. 130, 1897.—DALLA TORRE, *Catalogus hymenopterorum*, vol. 5, p. 384, 1898.—ASHMEAD, *Trans. Ent. Soc. London*, vol. 48, p. 336, 1900; *Mem. Carnegie Mus.*, vol. 1, p. 326, 1904.—SCHMIEDEKNECHT, *Genera insectorum*, fasc. 97, p. 39, 1909.—GOWDFY, *Rept. Govt. Ent. Jamaica Dept. Agr. for 1920*, p. 25, 1921.—WILSON, *Rept. Ent. Virgin Islands Agr. Exp. Stat. for 1920*, p. 21, 1921; *St. Croix Agr. Exp. Stat. Bull.* 3, p. 15, 1923; *Virgin Islands Agr. Exp. Stat. Bull.* 3, p. 5, 1923.—WOLCOTT, *Journ. Dept. Agr. Puerto Rico*, vol. 7, p. 61, 1923.—WINBURN and PAINTER, *Journ. Kansas Ent. Soc.*, vol. 5, p. 7, 1923.—LUGINBILL, *U. S. Dept. Agr. Techn. Bull.* 34, p. 74, 1928.—WOLCOTT, *Journ. Agr. Univ. Puerto Rico*, vol. 20, p. 536, 1936.

Sphex punctata FABRICIUS, *Species insectorum* . . . , vol. 1, p. 446, 1781.

Chalcis punctata (Fabricius) FABRICIUS, *Mantissa insectorum* . . . , vol. 1, p. 272, 1787.—GMELIN, *Systema naturae*, ed. 13, vol. 1, p. 2743, 1790.—OLIVIER, *Encyclopédie méthodique*, vol. 5, p. 438, 1790.—FABRICIUS, *Entomologia systematica* . . . , vol. 2, p. 196, 1793; *Systema piezatorum* . . . , p. 161, 1804.

Conura punctata (Fabricius) SICHEL, *Ann. Soc. Ent. France*, ser. 4, vol. 5, pp. 360, 392, 1865.

Smicra punctata (Fabricius) WALKER, *Notes on Chalcididae*, p. 51, 1871.—CRESSON, *Trans. Amer. Ent. Soc.*, vol. 4, p. 57, 1872.—CAMERON, *Biologia Centrali-Americana, Hymenoptera*, vol. 1, p. 87, 1884.—HOWARD, *U. S. Dept. Agr. Bur. Ent. Bull.* 5, p. 35, 1885.

Smicra punctata (Fabricius) WOLCOTT, *Journ. Dept. Agr. Puerto Rico*, vol. 7, p. 63, 1923; *Journ. Agr. Univ. Puerto Rico*, vol. 20, p. 537, 1936.

Chalosis fasciata OLIVIER, *Encyclopédie méthodique*, vol. 5, p. 439, 1790.

Smicra subpunctata WALKER, *Ent. Mag.*, vol. 2, p. 25, 1834; vol. 5, p. 469, 1838.—CRESSON, *Proc. Ent. Soc. Philadelphia*, vol. 1, p. 38, 1862.

- Smicra subpunctata* (Walker) CRESSON, Trans. Amer. Ent. Soc., vol. 4, p. 57, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 36, 1885.
- Smicra nigropicta* CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 95, 1865; The Cresson types of Hymenoptera, p. 76, 1916.
- Smicra nigropicta* (Cresson) WALKER, Notes on Chalcididae, p. 51, 1871.—CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 38, 53, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 35, 1885.
- Smicra ignea* CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 92, 1865; The Cresson types of Hymenoptera, p. 75, 1916.
- Smicra ignea* (Cresson) WALKER, Notes on Chalcididae, p. 51, 1871.—CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 37, 49, 192, 1872; HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 34, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 377, 1898.—ASHMEAD, Trans. Ent. Soc. London, vol. 48, p. 337, 1900.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 35, 1909.
- Smicra mirabilis* CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 38, 53, 192, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 35, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 379, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 35, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 75, 1916.

This common tropical and subtropical species is most easily recognized by its very large compound eyes (fig. 7, *j*), the long and slender antennal flagellum with the three apical segments conspicuously shorter than the basal ones, the wide and deep scrobe cavity, and the usually large and acute basal tooth of the metafemur (fig. 12, *i*).

Description.—Yellow, orange, or red with variable black markings; dorsal side of flagellum, T-shaped mark on mesopraescutum, a longitudinal stripe on each lobe of mesoscutum, mesal angles of axillae, longitudinal mesal stripe on mesoscutellum, usually a round dorsal spot on outer dorsal surface of metacoxa, metatrochanters usually, outer ventral teeth and usually an apical spot on metafemur, variable mesal spot on propodeum, and usually apex of abdomen, black.

Female: 5.5–8 mm. Antennae inserted ventrad of center of frons (fig. 7, *f*), apex of scape exceeding level of posterior ocelli, pedicel five-eighths and ring segment one-eighth length of segment 4, segment 5 slightly shorter than 4, segments 5 to 10 gradually decreasing in length, so that segment 10 is only five-eighths length of 4, last three segments combined equal to third and fourth segments, exact shape of segments 12 and 13 variable, 12 usually much shorter than 11 or 13; scrobe cavity deep and wide, area of frons laterad of scrobe cavity very narrow (fig. 7, *f*); interantennal projection provided with a narrow anterior lamina; frons with lateral carinae, and provided with a few scattered punctures laterad of scrobe cavity and on lateral areas of frons ventrad of antennal bases, elsewhere minutely and obscurely reticulated; frontal tentorial pits located near anterior

margins of compound eyes, and dorsad of antennal bases (fig. 7, *f*); width of malar space one-third height of compound eyes, fronto-genal suture extending directly from compound eye to mandible, paralleled by two strong carinae; combined widths of compound eyes slightly greater than interocular width at level of antennal bases; left mandible with two teeth, ventral one slightly larger, right mandible with three teeth, ventral one more acute and slightly larger than others; diameter of posterior ocellus slightly less than one-half interocellar space.

Dorsum of thorax deeply and densely pitted; pubescence short, inconspicuous; anterolateral angles of pronotum with an obscure carina, anterior dorsal margin acarinate; parapsidal furrows distinct; prepectus narrow, slightly overlapping anterior end of tegula; apex of mesoscutellum with a very narrow lamina, which is strongly depressed on meson; metepisternum strongly punctured except at anterior and posterior ventral angles, unpunctured areas glabrous or very faintly reticulated, pubescence fine, scattered; metacoxae glabrous on outer dorsal and inner surfaces, elsewhere shallowly punctured and setose; metafemora glabrous, sparsely covered with short setae, outer ventral margin with 12 to 20 small teeth, basal one larger than others, often long, acute (fig. 12, *i*); inner tooth acute, metatibia with apex long, slender, acute.

Propodeum with a few short, lateral setae, surface covered by irregular carinae, areas between carinae minutely reticulated, no lateral projections present, spiracular slits strongly arced; petiole short, usually shorter than wide, but occasionally slightly longer than wide, glabrous or very minutely reticulated, basal lamina wide on ventral side, narrower on dorsal side, slightly depressed on dorsal meson, interrupted at dorsolateral angles, lateral carinae usually present on petiole; gaster acuminate, one-third to one-half longer than metafemur, abdominal segments 4 to 7 each with a sparse row of short lateral setae; eighth tergite lightly shagreened, sparsely covered with short, black setae, spiracular openings round; cerci small, almost round, located near posterior margin of epipygium; apex of ovipositor sheaths densely covered with short setae.

Male: 5.6 mm. Antennal scape (fig. 8, *r*) broad at apex; malar space one-fourth height of compound eye; combined widths of compound eyes slightly less than interocular width at level of antennal bases; inner tooth of metafemur sharp; petiole twice as long as wide, with lateral carinae obscure or wanting.

Type locality.—West Indies.

Types.—*Chalcis* No. 8, Fabricius collection, University of Kiel, Kiel, Germany, 5 specimens. Comparisons made by Dr. Olaw Schroeder, June 1936. Types much broken and moldy, sex not discernible.

There is some doubt that *S. femorata* is the correct name to use for this species, although it is fairly clear that Fabricius himself¹⁴ considered his species *Crabro femoratus* and *Chalcis punctata* the same. He used the name *punctata* for it in all his later works. The name *femorata*, however, has priority. Since Fabricius did not observe priority in the use of names proposed by other authors, it is not surprising to find that he did not observe priority in the use of his own names.

No specimens have been located that could be the types of *Crabro femoratus* Fabricius, so the specimens labeled *Chalcis punctata* in the Fabricius collection at Kiel University have been taken as the types. Dr. Olav Schroeder has kindly made a detailed study of these types for me. He states that the specimens sent for comparison are, on the basis of the structural characters I asked him to examine, the same as the types.

Types for the synonyms: *punctata* Fabricius, type apparently the same as that of *femorata*; *fasciata* Olivier, lost; *subpunctata* Walker, lost; *nigropicta* Cresson, 1816.1–1816.6, Academy of Natural Sciences of Philadelphia; *igneae* Cresson, 1812, Academy of Natural Sciences of Philadelphia; *mirabilis* Cresson, 1792.1–1792.2, Academy of Natural Sciences of Philadelphia, and 1656, U. S. National Museum.

The available specimens of this species show distinct, but intergrading, differences in structure. Almost all the forms of this species, both the extremes and the intermediates, have already been described and named. I prefer to retain the single name for all of them, as no reliable means has been found for separating them. The species *Chalcis fasciata* Olivier and *Smiera subpunctata* Walker have been synonymized with *S. femorata* by Kirby¹⁵ and as the types are lost, and the original descriptions show no reliable distinctions, they may as well be left in synonymy.

There are, in the Tropics, a great many species, both described and undescribed, closely related to this one. To judge from the collections of tropical Chalcididae I have seen, *S. femorata* is perhaps the commonest species of this group in the West Indies and Central America, particularly in cultivated areas.

Hosts.—I have seen no reared material of this species, but the following records of hosts have been published for *Spilochalcis femorata*: *Laphygma frugiperda* Abbot and Smith [Wilson], *Heliothis obsoleta* (Fabricius) [Winburn and Painter] (Lepidoptera, Noctuidae).

Distribution.—Florida, Georgia, Texas, Cuba, Haiti, Panama, Puerto Rico.

¹⁴ *Entomologia systematica*, vol. 2, p. 196, 1793.

¹⁵ *Journ. Linn. Soc. London, Zool.*, vol. 17, p. 66, 1883.

SPIOCHALCIS IGNEOIDES (Kirby)

FIGURES 8, *s*; 9, *t*

- Smicra igneoides* KIRBY, Journ. Linn. Soc. London, Zool., vol. 17, p. 71, 1883.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—SMITH, Geol. Surv. New Jersey, Catalogue of insects, p. 38, 1890.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 377, 1898.—SMITH, Ann. Rept. New Jersey State Board Agr., vol. 27, suppl., p. 553, 1900.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 35, 1909.
- Smicra vittata* ASHMEAD, Trans. Amer. Ent. Soc., vol. 12, p. x, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 234, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 383, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 36, 1909.
- Spilochalcis vittata* (Ashmead) GOSSARD, Florida Agr. Exp. Stat. Bull. 79, p. 288, 1905.—GILL, U. S. Dept. Agr. Dept. Bull. 371, p. 15, 1917; U. S. Dept. Agr. Farmers' Bull. 843, p. 21, 1917.—WILSON, Rept. Ent. Virgin Islands Agr. Exp. Stat. for 1921, p. 21, 1922; Virgin Islands Agr. Exp. Stat. Bull. 3, p. 21, 1923.—LUGINBILL, U. S. Dept. Agr. Techn. Bull. 34, p. 74, 1928.—WINEBURN and PAINTER, Journ. Kansas Ent. Soc., vol. 5, p. 7, 1932.
- Spilochalcis mesillae* COCKERELL, Ann. Mag. Nat. Hist., ser. 6, vol. 19, p. 403, 1897.

At first glance this species seems quite distinct from all others, but it is actually difficult to find infallible characters to separate the females from those of *S. mariae* (Riley). The female of this species can best be recognized by the following characters: Body rather long and narrow, transverse carinae of mesopraescutum strong, abdomen acuminate, forewings with a brown spot around the stigmal vein, metafemur with a small inner tooth; the longitudinal mesal stripe of the mesonotum usually gradually widens anteriorly. In the male the scape is strongly incised (fig. 8, *s*), but the pedicel is cylindrical (fig. 9, *t*) rather than triangular as in *S. mariae* (fig. 9, *u*).

Description.—Yellow or red with black markings; scrobe cavity, usually two small spots on frons just ventrad of ocelli, mesal stripe between posterior ocelli, occipital area, usually meson of pronotum, usually a broad, longitudinal band extending from apex of mesoscutellum to anterior margin of mesopraescutum, parapsidal furrows, sometimes broad spots at anteromesal angles of lobes of mesoscutum, posterior margins of axillae, variable marks on mesopleuron, usually a dorsal stripe on metacoxa of female, with both a dorsal and ventral stripe in male, teeth of metafemur, usually a mesal stripe and areas around spiracles on propodeum, and apex of ovipositor sheath, black; male often with a black stripe on frontogenal suture; wings brownish, with a dark-brown spot surrounding stigmal vein.

Female: 4.5–8.5 mm. Antennal scape exceeding, by one-fifth its length, level of posterior ocellus, pedicel five-sixths and ring segment one-quarter length of segment 4, segment 4 slightly longer than

5, 5 to 8 equal, 9 and 10 slightly shorter, 11 and 12 combined equal to or slightly shorter than 10, 13 variable, usually minute; scrobe cavity shallow, margin indistinctly carinate at ventrolateral angles; one to three transverse carinae present in scrobe cavity just ventrad of anterior ocellus; interantennal projection with anterior carina continued up into scrobe cavity; frons with a few shallow pits near lateral margins, elsewhere minutely shagreened, several strong carinae extending laterad from anterior ocellus; frontal tentorial pits located just laterad of antennal bases; malar space usually slightly less than one-third height of compound eye, in large specimens, slightly wider; frontogenal suture almost straight; combined widths of compound eyes slightly greater than interocular space; left mandible with two teeth, right with three; diameter of posterior ocellus slightly less than two-thirds width of interocellar space.

Surface of pronotum and mesoscutellum shallowly punctured, areas between punctures lightly shagreened, remainder of dorsum of thorax provided both with carinae and irregular punctures; pubescence long, fine; anterolateral angles of pronotum carinate, anterior dorsal carina interrupted on mesal one-quarter to one-third, pronotum often with a carina at posterior margin on meson; prepectus narrow, apex not quite reaching tegula; apex of mesoscutellum with an extremely narrow, mesally depressed lamina; metepisternum shallowly pitted, areas between punctures almost glabrous, pubescence long; metacoxae glabrous on outer dorsal surface, covered with short setae on outer ventral surface, minutely shagreened near apex on ventral side; metafemur glabrous on outer surface, densely covered by short setae, ventral margin provided with 16 to 24 minute teeth, basal one slightly larger; small inner tooth present; apex of metatibia acute.

Propodeum with a few lateral setae, surface provided with strong mesal and apical carinae, laterobasal areas almost smooth, small tooth present at each posterolateral angle, spiracular openings oblique; petiole short, less than twice as long as wide, basal lamina narrow, lateral carinae usually present near base, but almost always becoming obsolete before apex; gaster one-third to one-half longer than metafemur; abdominal tergites 4 to 7 each with a double row of lateral setae; eighth tergite minutely shagreened, sparsely setose, spiracular openings oval, anterior margin often with a minute rounded projection; cerci small, oval, located near posterior margin of epipygium; apex of ovipositor sheaths with long setae.

Male: 4.5-6 mm. Inner margin of scape strongly incised (fig. 8, *s*), pedicel cylindrical (fig. 9, *t*), combined lengths of antennal segments 11 and 12 usually equal to segment 13; malar space always with a single long seta on each side of frontogenal suture, width of malar

space slightly less than one-third height of compound eye; combined widths of compound eyes one-fifth greater than interocular space at level of antennal bases; petiole slightly more than twice as long as wide; gaster usually equal in length to metafemur.

Type locality.—"United States."

Types.—Holotype, female, British Museum; comparisons made by Dr. Ch. Ferrière. Synonyms: *vittata* Ashmead, 40006, U. S. National Museum; *mesillae* Cockerell, 4075, U. S. National Museum.

Dr. Ch. Ferrière has kindly sent me detailed sketches and notes on the type of this species. The type of *S. vittata* Ashmead differs only in having the color markings very small and the transverse carinae of the mesopraescutum slightly weaker. The type of *S. mesillae* Cockerell is larger and has very broad color markings on the thorax, but otherwise it cannot be distinguished. I have a series of 54 specimens from localities all over the United States, and in this series all gradations are present between the form of *vittata*, with its small color bands, and *mesillae* with the color bands very broad.

The variation in coloration of this species seems to correlate very well with the mean temperatures of the localities where it has been collected, as the specimens from either high elevations or northern localities have very broad markings, while specimens from southern localities or low altitudes have the color bands narrow. This variation in color does not seem to correlate with variations in humidity, as specimens from the deserts of southern New Mexico or California are identical in coloration with specimens from the coast of Massachusetts.

Hosts.—I have seen no reared material of this species, but the following host records have been published under the name *Spilochalcis vittata*: *Mineola indigenella* Zeller [Gossard] (Lepidoptera, Pyralidae); *Laphygma frugiperda* Abbot and Smith [Wilson], *Heliothis obsoleta* (Fabricius) [Winburn and Painter] (Noctuidae).

Distribution.—Alberta, California, Florida, Georgia, Illinois, Indiana, Kansas, Massachusetts, Montana, New Hampshire, New Jersey, North Carolina, Oklahoma, Rhode Island, South Dakota, Texas, Virginia.

SPILOCHALCIS MARIAE (Riley)

FIGURES 8, *t*; 9, *u*; 10, *h*; 12, *f*

Chalcis mariae RILEY, Amer. Ent., vol. 2, p. 101, 1870; 4th annual report on the noxious, beneficial and other insects of the State of Missouri, p. 109, 1872.—GENTRY, Can. Ent., vol. 9, p. 50, 1877.—BRUNER, Nebraska Agr. Exp. Stat. Bull. 14, p. 140, 1890; Rept. Nebraska State Hort. Soc. for 1891, p. 220, 1892; Preliminary introduction to the study of entomology, p. 101, 1894.

Smicra mariae (Riley) CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 38, 52, 1872.—GLOVER, Illustrations of North American entomology, pl. 1, fig. 33, 1878.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 238, 1887.—SMITH, Geol. Surv. New Jersey, Catalogue

of insects, p. 38, 1890.—HOWARD, Proc. Ent. Soc. Washington, vol. 1, p. 11, 1895.—SMITH, Ann. Rept. New Jersey State Board Agr., vol. 27, suppl., p. 554, 1900.—GIRAULT, Ent. News, vol. 25, p. 283, 1914.

Spilochalcis mariae (Riley) HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, pp. 6, 35, 1885.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 285, 1898.—VIERECK, Trans. Amer. Ent. Soc., vol. 32, p. 184, 1906.—HOWARD and CHITTENDEN, U. S. Dept. Agr. Circ. 97, p. 7, 1908.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 40, 1909.—SMITH, Ann. Rept. New Jersey State Mus. for 1909, p. 649, 1910.—VIERECK, Connecticut Geol. and Nat. Hist. Surv. Bull. 22, p. 527, 1916.—HOWARD and CHITTENDEN, U. S. Dept. Agr. Farmers' Bull. 701, p. 7, 1916.—RUHL, Soc. Ent. Stuttgart, vol. 36, p. 11, 1921.—BAERG, Ontario Dept. Agr. Bull. 224, p. 8, 1928.—ISELY, Arkansas Agr. Exp. Stat. Bull. 203, p. 32, 1926.—LEONARD, Cornell Univ. Agr. Exp. Stat. Mem. 101, p. 976, 1928.—JOHNSON, Nantucket Maria Mitchell Assoc. Publ. 3, p. 109, 1930.—MONTGOMERY, Can. Ent., vol. 65, p. 185, 1933.—SCHAFFNER and GRISWOLD, U. S. Dept. Agr. Misc. Publ. 188, p. 152, 1934.

Spilochalcis trinidadensis ASHMEAD, Mem. Carnegie Mus., vol. 1, p. 437, 1904.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 41, 1909.

Spilochalcis insularis ASHMEAD, Mem. Carnegie Mus., vol. 1, p. 437, 1904.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 40, 1909.

The male of this species differs from all other North American species in the genus in having the antennal pedicel triangular instead of cylindrical (see fig. 9, *u*); the female is most easily recognized by the quite constant color pattern of the dorsum of the thorax, the short, stout petiole, with distinct lateral carinae, and the metafemora being without an inner tooth.

Description.—Yellow or red with black markings; flagellum of antennae, occiput, mesal spot on anterior surface of pronotum, anterior and posterior margins and longitudinal mesal stripe of mesopraescutum, parapsidal furrows, longitudinal mark on each lobe of mesoscutum, posterolateral angles of axillae, longitudinal mesal stripe of mesoscutellum, variable dorsal stripe or spot and apex of metacoxae, metatrochanters usually, teeth of metafemur, variable basal spot of propodeum, usually narrow transverse dorsal stripes on gaster, and apex of ovipositor sheaths, black; male almost always with both a dorsal and ventral black stripe on metacoxae.

Female: 4.5–10 mm. Apex of antennal scape exceeding, by one-fourth its length, level of posterior ocelli, scape and ring segment usually equal in length, their combined lengths equal to segment 4, segments 4 to 7 usually equal, 7 sometimes slightly shorter, 8 and 9 always shorter than 7, 10 variable in length, usually slightly shorter than 9, last three segments indistinctly divided, their combined lengths usually equal to segment 4; scrobe cavity shallow, edge carinate at ventral margin and on ventral one-half of lateral margins, the latter strongly curved mesad; interantennal projection with a slight anterior carina; frons with a few scattered, indistinct punctures, oblique carinae radiating from ventral and lateral margins of anterior ocellus, usually three transverse carinae present in scrobe

cavity just ventrad of antennal bases; frontal tentorial pits located very near antennal bases, at level of ventral margin of scrobe cavity; width of malar space approximately one-third height of compound eye; frontogenal suture straight; combined widths of compound eyes four-fifths interocular width at level of antennal bases; left mandible with two teeth, right with three; diameter of posterior ocellus usually two-thirds interocellar width, sometimes slightly less; vertex strongly depressed between posterior ocelli.

Dorsum of thorax scatteringly covered by punctures and short, slightly irregular transverse carinae; pubescence indistinct; anterolateral angles of pronotum carinate, anterior dorsal margin with carina varying from strong to weak, this carina interrupted on mesal one-eighth to one-third; parapsidal furrows distinct; prepectus usually concealed, occasionally visible as a very narrow, blade-like sclerite extending to tegula; apex of mesoscutellum with a minute lamina which is strongly depressed on meson; metepisternum partly glabrous, anteroventral angle sometimes minutely shagreened, a few shallow punctures present; metacoxae completely glabrous, sparsely covered by rather long pubescence except on outer dorsal surface; metafemur (fig. 12, *j*) glabrous on outer surface, densely covered by short pubescence, ventral margin with 14 to 22 small, closely set teeth, the basal one larger; inner tooth wanting; metatibia with apex narrow, acute.

Propodeum with two lateral areas at base covered by minute, irregular reticulations, well-developed carinae on meson and at apex, a blunt lateral projection present on either side of point of insertion of petiole, spiracular openings vertical; petiole usually as wide as long, occasionally slightly longer, basal lamina narrow, distinct lateral carinae present, area of petiole ventrad of lateral carinae lightly shagreened; gaster one-third to one-half longer than metafemur, abdominal tergites three to seven each with a sparse row of lateral setae; eighth tergite minutely shagreened, sparsely covered by long setae, spiracular openings oval; cerci oval, small, located near posterior margin of epipygium, usually provided with five long setae; apex of ovipositor sheath densely covered with short setae.

Male: 4-7 mm. Mesal margin of antennal scape strongly incised (fig. 8, *t*), pedicel triangular (fig. 9, *u*); width of malar space one-quarter height of compound eye; combined widths of compound eyes equal to width of interocular space at level of antennal bases; petiole slightly longer than wide at widest point; cerci large, located midway between base and apex of ninth tergite.

Type locality.—Missouri.

Types.—Holotype, female, 2788, U. S. National Museum; the allotype has apparently been lost, although both the male and female were mentioned in the original description. Synonyms: *trinidaden-*

sals Ashmead, H. H. Smith collection, Carnegie Museum; *insularis* Ashmead, H. H. Smith collection, Carnegie Museum.

The types of *S. trinidadensis* and *S. insularis* Ashmead are slightly smaller and more lightly colored than the typical *S. mariae*, but otherwise they do not differ. Size and color differences alone are not reliable specific differences in this genus.

Hosts.—*Thyridopteryx ephemeraeformis* Haworth (Lepidoptera, Psychidae); *Philosamia cynthia* Drury, *Samia cecropia* (Linnaeus), *Callosamia promethea* Drury, *Telea polyphemus* Cramer, *Rothschildia* sp. (Saturniidae).

Distribution.—Arizona, Colorado, District of Columbia, Florida, Georgia, Illinois, Kansas, Louisiana, Maryland, Missouri, New Jersey, New York, North Carolina, Pennsylvania, South Carolina, Texas, Virginia, Wisconsin.

Trinidad, B. W. I.

SPILOCHALCIS CLORA, new species

FIGURE 9, a

This species differs only slightly from *S. mariae* (Riley) redescribed on page 304.

Description.—Female: Unknown.

Male: 3.5–4 mm. Identical with the male of *S. mariae* (Riley) except in the following characters: Antennal scape narrow at base, broadened somewhat at apex (fig. 9, a), apex only shallowly excavated, outer anterior angle rounded, rather than acutely produced, as in *S. igneoides* (Kirby) (fig. 8, s) or *S. mariae* (Riley) (fig. 8, t); pedicel cylindrical, three-fourths the length of segment 4, ring segment one-half the length of 4, segments 5 to 10 equal in length, only slightly longer than wide, last three segments slightly shorter than 10; width of malar space three-fourths the height of compound eye; frontogenal suture slightly curved; combined widths of compound eyes one-sixth to one-fifth wider than interocular space at level of antennal bases; diameter of posterior ocellus one-half the interocular width; outer surface of metafemur slightly reticulated near dorsal margin, glabrous ventrad, ventral margin with 16 to 18 minute, closely set teeth; inner tooth lacking; petiole twice as long as wide, basal lamina narrow, lateral carinae present only near base; gaster equal in length to metafemur.

Type locality.—Texas.

Types.—Holotype, male, College Station, Tex., September, Banks; paratypes, Mission, Tex., December 5, 1910, 2 males; Scott County, Ark., August 23, 1928, R. H. Beamer, 1 male. Holotype deposited in the U. S. National Museum, two paratypes in Illinois State Natural History Survey collection, one paratype in Kansas State College; Manhattan, Kans.

A good series of material from the Southwestern States is needed so that it will be possible to associate the females of this species with these males.

Host.—Unknown.

SPILOCHALCIS PHAIS, new species

FIGURE 9, b

This species differs only slightly from *S. mariae* (Riley) redescribed on page 304.

Description.—Female: 5–6.5 mm. Except for the characters mentioned in key above, identical with female of *S. mariae*.

Male: 4–5 mm. Identical with the male of *S. mariae*, except in the following characters: Anteromesal margin of antennal scape only slightly sinuate near apex (fig. 9, b), not strongly incised as in *S. igneoides* (Kirby) (fig. 8, s) or *S. mariae* (fig. 8, t), scape broadened from base to apex, apex deeply excavated, outer anterior apex rounded, rather than acutely produced, as in *S. mariae* (fig. 8, t); pedicel cylindrical, two-thirds the length of segment 4, ring segment one-quarter the length of segment 4, segments 5 to 10 equal, somewhat variable, usually longer than wide, last three segments slightly shorter than 10; width of malar space three-tenths the height of compound eye; frontogenal suture slightly curved; combined widths of compound eyes equal to or slightly greater than interocular space at level of antennal bases; diameter of posterior ocellus one-half the width of interocellar space; outer surface of metafemur glabrous, ventral margin provided with 12 to 18 minute, closely set teeth; petiole slightly less than twice as long as wide, basal lamina narrow, lateral carinae wanting; gaster slightly longer than metafemur.

Type locality.—Texas.

Types.—Holotype, male, Brownsville, Tex., May 1921, J. C. Bridwell; paratypes, Brownsville, Tex., May 1921, J. C. Bridwell, 1 male, C. H. T. Townsend, 409, 1 male, Victoria, Tex., 1 male, Maverick County, Tex., December 29, 1915, J. D. Mitchell, 1 male. All types deposited in the U. S. National Museum.

Host.—The specimen collected by J. D. Mitchell in Maverick County, Tex., was reared from the pupa of a moth probably belonging to the family Ceratocampidae, although this host pupa is too poorly preserved to be identified accurately.

The xanthostigma Group

The *xanthostigma* group includes the genotype of *Spilochalcis*. Most of the species of *Spilochalcis* described from India and Africa are also apparently referable to this group. All the species of this group are rather rare, but most of them are widely distributed.

Aside from the short antennal scape, this group is recognized by the stout flagellum and the head being, when viewed from the dorsal aspect, nearly one-half as long as wide. The vertex is broadly rounded so that the anterior ocellus is directed somewhat dorsad rather than in the usual anterior direction; the thorax is, in all but one species in this area, quite compact and broad (fig. 10, *c*). The teeth of the metafemora are invariably minute and closely set, and the basal tooth is usually no larger than the following ones.

KEY TO SPECIES OF THE XANTHOSTIGMA GROUP

1. Female, ninth abdominal sternite concealed, antennal scape slender..... 2
 Male, ninth abdominal sternite exposed, antennal scape broad..... 10
2. Abdomen greatly elongated, acuminate, dorsal length of epipygium twice as great as length of eighth tergite..... *tanais* (p. 309)
 Abdomen short, dorsal length of epipygium equal to or slightly less than length of eighth tergite..... 3
3. Left mandible with three teeth..... *juxta* (p. 311)
 Left mandible with two teeth..... 4
4. Interantennal projection with a thin, conspicuously projecting anterior lamina (as in fig. 7, *g*)..... *arcana* (p. 313)
 Interantennal projection either smooth or with a minute anterior carina..... 5
5. Dorsum of pronotum with a distinct anterior carina (fig. 10, *c*)..... 6
 Dorsum of pronotum acarinate at anterior margin..... 7
6. Petiole less than twice as long as wide..... *apalis* (p. 315)
 Petiole three times as long as wide..... *melana* (p. 316)
7. Outer dorsal surface of metacoxa glabrous..... 8
 Outer dorsal surface of metacoxa shagreened..... 9
8. Lateral ocelli almost contiguous with compound eyes..... *pallens* (p. 319)
 Lateral ocelli separated from margins of compound eyes by a space at least equal to diameter of ocellus..... *xantha* (p. 320)
9. Width of space between posterior ocellus and margin of compound eye less than diameter of posterior ocellus..... *odontotae* (p. 321)
 Width of space between posterior ocellus and margin of compound eye greater than diameter of posterior ocellus..... *subobsoleta* (p. 323)
10. Thorax elongate, slender (fig. 10, *b*), width of posterior margin of mesopraescutum two-fifths its length..... *tanais* (p. 309)
 Thorax short, compact (fig. 10, *c*), width of posterior margin of mesopraescutum one-half its length..... 11
11. Left mandible with three teeth..... *juxta* (p. 311)
 Left mandible with two teeth..... 12
12. Interantennal projection with a thin, conspicuously projecting anterior lamina (as in fig. 7, *g*)..... *arcana* (p. 313)
 Interantennal projection either smooth or with a minute carina..... 13
13. Outer dorsal surface of metacoxa glabrous..... 14
 Outer dorsal surface of metacoxa shagreened..... 15
14. Lateral ocelli almost contiguous with compound eyes..... *pallens* (p. 319)
 Lateral ocelli separated from margins of compound eyes by a space at least equal to diameter of ocellus..... *lecta* (p. 317)

15. Anterior dorsal margin of pronotum with a transverse carina
(fig. 10, *c*)----- *melana* (p. 316)
Anterior dorsal margin of pronotum acarinate----- 16
16. Width of space between posterior ocellus and margin of compound eye one-third diameter of posterior ocellus----- *odontotae* (p. 321)
Width of space between posterior ocellus and margin of compound eye equal to or slightly greater than diameter of posterior ocellus----- 17
17. Frontal tentorial pits located near bases of antennae; dorsum of thorax black with yellow spots----- *subobsoleta* (p. 323)
Frontal tentorial pits located midway between antennal bases and anterior margins of compound eyes; dorsum of thorax entirely black----- *pallipes* (p. 325)

SPILOCHALCIS TANAIIS, new species

FIGURES 9, *c*; 10, *b*

In having the antennal scape short, the flagellum stout, and the vertex broadly rounded, this species agrees with *S. subobsoleta* (Cresson) but differs in having the scrobe cavity shallow, the body elongate rather than compact, the abdomen of the female acuminate instead of semiglobose, the mesopraescutum as long as wide at the widest point (fig. 10, *b*), not wider than long (fig. 10, *c*), and the metafemora rather narrow instead of semiglobose.

Description.—Yellow with variable brown and black markings. The following areas usually brown: Apices of mandibles, areas of frons just cephalad of ocelli, occiput, mesal and two lateral spots on dorsum of pronotum, all but lateral margins of mesoscutum and praescutum, axillae except mesal angles, mesal area of mesoscutellum, most of ventral and lateral areas of thorax, metacoxae, and metafemora except basal, apical, and dorsal spots, lateral margins and meson of propodeum, and transverse dorsal stripe on each segment of gaster. The following parts usually black: Mesal stripe between posterior ocelli, occiput near cervicum, longitudinal mesal stripe on mesopraescutum and scutellum, variable marks on pleura, cephalo-ventral angle of metepisternum, small area ventrad of propodeal spiracles, transverse stripes on eighth tergite and base of epipygium, and apex of ovipositor sheath.

Female: 4–6 mm. Apex of antennal scape not quite reaching level of ventral margin of anterior ocellus, pedicel three-quarters and ring segment one-quarter length of segment 4, segment 5 slightly shorter than 4, segments 5 to 10 decreasing progressively in length, so that 10 is one-quarter shorter than 4, 11 and 12 variable, usually equal to 10, 13 one-half or less length of 10; scrobe cavity shallow, edge carinate only at ventral margin; interantennal projection with a minute dorsal carina; frons pitted lateral to scrobe cavity and on narrow lateral areas ventrad of antennal bases, elsewhere minutely reticulated, uni-

formly but sparsely covered by rather long setae; frontal tentorial pits located slightly ventrad and laterad of antennal bases; width of malar space slightly less than one-third height of compound eye; frontogenal suture almost straight; combined widths of compound eyes almost equal to interocular width at level of antennal bases; left mandible with two teeth, right with three; diameter of posterior ocellus three-sevenths interocellar width.

Dorsum of thorax shallowly and irregularly pitted, punctures lacking along anterior margin of mesopraescutum, areas between pits minutely reticulated; pubescence long, dense at posterior margin of pronotum, on meson and at posterior margin of mesopraescutum, parapsidal furrows, and lateral margins of mesoscutellum; anterolateral angles of pronotum slightly carinate, anterior dorsal margin with a minute carina which is interrupted on mesal one-third; parapsidal furrows distinct; only a small triangular area of prepectus visible at anterolateral angles of mesoscutum; mesoscutellum with a very narrow apical lamina; metepisternum thickly punctured and densely covered by long setae; metacoxa almost glabrous on outer dorsal and inner surfaces, elsewhere shallowly punctured and setose; metafemur with outer surface minutely reticulated, densely covered by short setae; outer ventral margin with 12 to 15 small teeth, basal one slightly larger than others; blunt inner tooth present.

Propodeum with strong mesal and apical carinae, elsewhere minutely shagreened, a small tooth present at each posterolateral angle, spiracular openings vertical; petiole short, only one and one-half times as long as wide, dorsal surface glabrous, basal lamina narrow, short lateral carinae present near base; gaster one-fourth to one-third longer than metafemur, abdominal segments 5 to 7 each with a pair of lateral patches of setae, segments 4 to 7 each with a double row of setae on dorsal surface; eighth tergite minutely reticulated, covered by rather long pubescence, spiracular openings round; epipygium conspicuously setose, cerci oval, situated near posterior margin of epipygium; apex of ovipositor sheaths with dense, short, ventral setae.

Male: 4 mm. Antennal scape (fig. 9, c) slightly shorter than in female; width of malar space one-third height of compound eye; combined widths of compound eyes equal to interocular space; inner tooth of metafemur small, obscure; petiole twice as long as wide.

Type locality.—California.

Types.—Holotype, female, Saticoy, Calif., November 29, 1930, ex *Gnorimoschema* sp. pupa on *Solanum*; allotype, male, Childress, Tex., September 9, 1908, ex *Gnorimoschema* sp. pupa from stem of *Polygonum pennsylvanicum*, Hunter No. 1082, E. S. Tucker; paratypes, Brownsville, Tex., November 19, 1911, in pasture in southern Texas gardens, 1 female, November 23, 1910, sweeping on Indian Plains,

1 female. Holotype and allotype deposited in the U. S. National Museum; paratypes deposited in Illinois State Natural History Survey collection.

Host.—*Gnorimoschema* sp. (Lepidoptera, Gelechiidae).

SPILOCHALCIS JUXTA (Cresson)

FIGURES 7, *g*; 9, *d*

Smicra juxta CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 38, 54, 1872.—CAMERON, Biologia Centrali-Americana, Hymenoptera, vol. 1, p. 87, 1884.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 34, 1885.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 378, 1898.—SCHMIEDEKNECHT, Genera Insectorum, fasc. 97, p. 35, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 75, 1916.

Spilochalcis nigropleuralis ASHMEAD, Mem. Carnegie Mus., vol. 1, p. 436, 1904.—SCHMIEDEKNECHT, Genera Insectorum, fasc. 97, p. 40, 1909.

This compact species is most readily recognized by its rounded head, which is one-half as long as wide when viewed from the dorsal aspect, the stout antennal flagellum, and the strong lamina projecting cephalad from the interantennal projection (fig. 7, *g*).

Description.—Yellow with black markings; antennal flagellum dark brown, the three apical segments usually red; occipital area of head, all but lateral margins of mesopraescutum and lobes of mesoscutum, anterior basal areas of axillae, mesal longitudinal stripe of mesoscutellum, apices of metacoxae, small basal, apical, and ventral rectangular marks on outer side of metafemur, most of propodeum, entire petiole, and most of gaster, black.

Female: 4.5–5 mm. Apex of antennal scape not quite attaining level of ventral margin of anterior ocellus, pedicel four-fifths and ring segment one-fifth length of segment 4, 4 to 10 equal in length, 11, 12, and 13 shorter, their combined lengths one-fifth less than length of segments 9 and 10; scrobe cavity deep, edge carinate only at ventral margin; interantennal projection provided with a conspicuous anterior lamina (fig. 7, *g*); frons with area between scrobe cavity and compound eyes somewhat produced cephalad, surface of frons densely punctured except immediately dorsad of clypeus; frontal tentorial pits usually obscure, located at level of ventral margin of scrobe cavity; malar space one-third height of compound eye; frontogenal suture extending in a low arc from compound eye to mandible, a strong secondary carina extending from point near dorsal articulation of mandible to posterior margin of compound eye; combined widths of compound eyes equal to interocular space at level of antennal bases; left mandible with three nearly equal teeth, right mandible with three teeth, ventral one largest; diameter of posterior ocellus three-fourths width of interocellar space.

Dorsum of thorax coarsely punctate, spaces between punctures narrow, minutely reticulated; pubescence long, generally sparse on meson

of dorsal area; anterolateral margins of pronotum strongly carinate; anterior dorsal carina interrupted on mesal one-fifth; prepectus narrow, tongue-shaped, extending to tegula; anterior margin of mesoscutellum with a minute mesal notch, apex of mesoscutellum with a narrow, mesally depressed lamina; metepisternum strongly punctured, pubescence long and dense; metacoxa rather squarely truncate at base, surface glabrous, provided with sparse, short pubescence on ventral side; outer surface of metafemur densely covered by short pubescence, from 17 to 24 small, blunt, closely set teeth present on ventral margin; distinct inner tooth present.

Propodeum provided with a few large carinae, two lateral areas at base minutely shagreened, a small tooth present at each posterolateral angle, spiracular openings nearly vertical; petiole slightly more than twice as long as wide at widest point, basal lamina wide on ventral side, slightly narrower on dorsal side; prominent lateral grooves usually present; gaster slightly longer than metafemur, third abdominal segment usually as long as all following segments combined, lateral row of setae usually present only on segment 4, although some specimens have a few lateral setae on segment 6 or 7; eighth tergite minutely reticulated, sparsely pubescent; spiracular openings minute, round; cerci oval, located near posterior margin of epipygium and provided with five to seven long setae; apices of ovipositor sheaths with a few ventral setae.

Male: 4-4.5 mm. Antennal scape (fig. 9, *d*) stout; combined widths of compound eyes one-third less than width of interocular space at level of antennal bases; petiole two and one-half times as long as wide.

Type locality.—Mexico.

Types.—Holotype, female, 1808.1; paratype, 1808.2: Academy of Natural Sciences of Philadelphia. Synonym: *nigropleuralis* Ashmead, H. H. Smith collection, Carnegie Museum.

The types of *nigropleuralis* Ashmead differ very slightly from those of *S. justa* Cresson in the distinctness of the carinae of the genae. The available material shows this difference to intergrade.

Host.—Unknown.

Distribution.—ILLINOIS: Monticello, June 11, 1934, Frison and DeLong, 1 male. KANSAS: Atchison County, July 11, 1924, R. H. Beamer, 1 male. MARYLAND: Cabin John, September 2, 1914, R. C. Shannon, 1 female. TEXAS: Brownsville, February 8, 1926, P. A. Glick, 1 male.

MEXICO: Sumichrast, 2 females (holotype and paratype); Matamoros, August 10-12, 1903, W. L. Tower, 1 female, 1 male.

TRINIDAD, B. W. I.: 1 female, 1 male (cotypes of *nigropleuralis* Ashmead).

BRAZIL: Chapada, 1 female (cotype of *nigropleuralis* Ashmead).

SPILOCHALCIS ARCANA (Cresson)

FIGURE 9, c

- Smicra arcana* CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 36, 44, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 33, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 373, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 34, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 74, 1916.
- Smicra encausta* CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 37, 46, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 34, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 376, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 35, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 74, 1916.

This usually red or orange species is most easily recognized by its compact form, short antennal scape and stout flagellum, very broad anterolateral carina of the pronotum, prominent anterior lamina on the interantennal projection, and the semiglobose metafemora with 18 or more small, closely set teeth, the basal one of which is acute.

Description.—Red, orange, or yellow with broad black marks; vertex and occiput, mesopraescutum except two wedge-shaped lateral marks, lobes of mesoscutum except anterolateral angles, axillae, narrow longitudinal mesal and short apical marks on mesoscutellum, metacoxae except small dorsal stripe, central and small apical spots on outer side of metafemur, entire propodeum, petiole, and gaster, except bases of third and fourth segments, black.

Female: 4–5 mm. Apex of antennal scape not quite reaching level of ventral margin of anterior ocellus, pedicel four-fifths and ring segment two-fifths length of segment 4, 5 slightly shorter than 4, 5 to 11 almost equal in length, 12 and 13 combined only slightly longer than 11; scrobe cavity deep, edge carinate at ventral margin; interantennal projection provided with a strong anterior lamina; frons deeply and closely punctured, punctures tending to coalesce so as to form irregular transverse and oblique carinae, frontal tentorial pits located just laterodorsad of antennal bases; width of malar space slightly less than one-half height of compound eye; frontogenal suture extending, for one-fourth its length, ventrad from compound eye, then curved abruptly toward mandible, genal area caudad of suture with three or four irregular transverse carinae; combined widths of compound eyes two-thirds interocular width at level of antennal bases; left mandible with two rather blunt teeth, right mandible with three acute teeth, ventral one largest; diameter of posterior ocellus slightly less than one-half interocellar width.

Dorsum of thorax deeply and thickly punctured, areas between punctures minutely reticulated; pubescence mostly short, but longer at posterior margins of pronotum and mesopraescutum; anterolateral angles of pronotum with a wide lamina, anterior dorsal carina interrupted on mesal one-fifth; parapsidal furrows nearly obliterated; prepectus narrow, its apex slightly overlapping anterior apex of tegula; mesoscutellum provided with a narrow apical lamina; metepisternum densely and deeply punctured, sparsely covered by long, slender setae; metacoxa stout, outer dorsal area glabrous or very nearly so, ventral and lateral areas provided with setae and large punctures; outer surface of metafemora densely covered by short pubescence, ventral margin with 19 to 24 small, acute, closely set teeth, basal one slightly larger and acute; inner tooth varying from acute to blunt; metatibia with apex acute.

Propodeum covered by strong, rather irregular carinae, a minute tooth present at each posterolateral angle, spiracular openings nearly vertical; petiole short, glabrous on dorsal side, minutely reticulated on lateral side near base, basal lamina narrow; gaster somewhat compressed, usually slightly smaller than metafemur, third abdominal segment usually occupying half or more total length of gaster, abdominal segments 4 to 7 with sparse lateral setae at posterior margins; eighth tergite minutely pitted and reticulated, sparsely covered by long setae, spiracular openings round; cerci small, almost round, located midway between anterior and posterior margins of epipygium; ovipositor sheaths provided with sparse, short ventral setae.

Male: 4.5–5 mm. Antennal scape (fig. 9, e) short and stout; combined widths of compound eyes one-half interocular space at level of antennal bases; inner tooth of metafemur sharp; petiole slightly more than twice as long as wide.

Type locality.—Delaware.

Types.—Holotype, male, 1786, Academy of Natural Sciences of Philadelphia. The female was described as *Smicra encausta* Cresson, from Colorado; type, 1789, Academy of Natural Sciences of Philadelphia.

The species *S. encausta* Cresson was originally stated to be described from a male, but the type is a female; it differs from the type of *S. arcana* only in having the anterolateral lamina of the pronotum slightly narrower, but is otherwise identical in structure (except in primary and secondary sexual characters), although somewhat darker in color. Neither of these differences is of specific value.

Host.—Unknown.

Distribution.—Alabama, Colorado, Delaware, Illinois, Manitoba, Minnesota, Montana, North Dakota.

SPILOCHALCIS APAHIS, new species

FIGURE 10, c

In having the antennal scape short and the flagellum stout, while the head, from the dorsal aspect, is almost one-half as long as wide, this species agrees with *S. justa* (Cresson) but differs in that the left mandible has only two teeth instead of three, the dorsum of the thorax is flattened, and the metacoxae and femora are minutely shagreened instead of glabrous.

Description.—Black; the following areas yellow: Frons laterad of scrobe cavity, genae, dorsal meson of pronotum, lateral margins of mesopraescutum and mesoscutum, mesal angles of axillae, basal and lateral margins of mesoscutellum, apices of profemora and meta-femora, all tibiae and tarsi, and subapical spot on outer ventral margin of metafemora; the following areas orange: Scape, pedicel, and segments 3 to 5 of antennae, narrow band across vertex, dorsolateral areas of pronotum, anteromesal areas of mesopraescutum, small mesal spots on lobes of mesoscutum, subbasal area of mesoscutellum, outer dorsal side of metacoxae, outer surface of metafemora, apex of propodeum, and transverse dorsal stripes on abdominal segments 3 and 4.

Female: 2.5–3 mm. Apex of antennal scape not quite reaching level of ventral margin of anterior ocellus, pedicel one-third longer than segment 4, ring segment one-sixth length of pedicel, segment 5 one-fifth longer than 4 and slightly longer than 6, 6 to 11 equal, 12 and 13 slightly shorter; scrobe cavity deep, and inconspicuous carina present on ventral half of each lateral margin, a short transverse carina present in scrobe cavity just ventrad of anterior ocellus; inter-antennal projection strongly produced cephalad but without a carina or lamina, frons deeply and densely pitted on area laterad of scrobe cavity, scatteringly punctured on lateral areas ventrad of antennal bases, impunctate on meson, pubescence long, scattered; frontal tentorial pits located just laterad of antennal bases; width of malar space one-third height of compound eye; frontogenal suture slightly arced, almost straight; combined widths of compound eyes four-fifths or slightly more width of interocular space at level of antennal bases; left mandible with two teeth, right with three; width of interocellar space two and two-fifths times the diameter of posterior ocellus; head, from dorsal aspect, slightly less than one-half as long as wide.

Dorsum of thorax (fig. 10, c) flattened, thickly covered with shallow, irregular punctures, area at anterior margin of mesopraescutum not punctured but shagreened; pubescence long, white or yellow; anterolateral angles of pronotum carinate, carina of anterior dorsal margin interrupted on mesal one-third; parapsidal furrows distinct; prepectus narrow, just reaching tegula; apex of mesoscutellum with

a narrow flange, which is only slightly depressed on meson; metepisternum with large, deep pits, pubescence long, sparse; metacoxa minutely shagreened on outer dorsal side, ventral side with short setae; outer surface of metafemora densely covered with short setae, 15-25 small, acute teeth present on ventral margin; inner tooth acute.

Propodeum provided with strong mesal and apical carinae, two basolateral areas more weakly and irregularly carinate, areas between carinae minutely reticulated, spiracular openings slightly slanted laterad, propodeum with a small projection at each posterolateral angle; petiole slightly less than twice as long as wide, all exposed surfaces with minute shagreening and short carinae, basal lamina narrow, interrupted at dorsolateral angles, lateral carinae present; gaster slightly longer than metafemur, abdominal tergites 4 to 7 with sparse lateral setae; eighth tergite minutely reticulated, sparsely setose, spiracular openings round; cerci oval, located midway between anterior and posterior margins of epipygium; apex of ovipositor sheath with a few short setae.

Male: Unknown.

Type locality.—Texas.

Types.—Holotype, female, Brownsville, Tex., May 26, 1919, C. Heinrich; paratypes, same data as holotype, 4 females. All types deposited in the U. S. National Museum.

Host.—Unidentified microlepidopteron on *Lantana horrida*.

SPILOCHALCIS MELANA, new species

FIGURE 9, *g*

This minute, black species bears a superficial resemblance to *S. side* (Walker), but the presence of a frontogenal suture in *S. melana* will separate them at once. This species is structurally close to *S. apaiis*, described above, in having the scape short, head broadly rounded, anterior margin of pronotum carinate, and the thorax broad and somewhat flattened (as in fig. 10, *c*); it differs in being almost entirely black instead of varicolored, having the petiole three times as long as wide (rather than only twice as long as wide), and having a minute carina on the interantennal projection.

Description.—Black; mandibles, antennal scape, protibiae, mesotibiae, and all tarsi, yellow. Conspicuously covered with long, white setae.

Female: 2 mm. Apex of antennal scape not reaching level of ventral margin of anterior ocellus, pedicel one and one-half and ring segment one-third length of segment 4, segments 5 to 10 equal, as wide as long, last three slightly shorter; scrobe cavity shallow, almost glabrous, lateral margins irregular; interantennal projection with a minute anterior carina; combined widths of compound eyes

five-sevenths interocular space at level of antennal bases; width of malar space one-third height of compound eye; diameter of posterior ocellus slightly more than one-third interocellar space.

Dorsum of thorax deeply and irregularly pitted, the pits tending to coalesce; anterolateral angles of pronotum carinate, anterior dorsal carina rather irregular, interrupted on mesal one-quarter; parapsidal furrows distinct; prepectus not quite reaching tegula; apical lamina of mesoscutellum not depressed on meson; metepisternum provided with large punctures except at posteroventral angle; metacoxa shagreened on outer dorsal surface, pitted and setose elsewhere; outer surface of metafemur shagreened and densely covered with rather long setae, outer ventral margin with 20 to 22 teeth, the basal one larger than others; sharp inner tooth present.

Propodeum coarsely carinate, areas between carinae minutely reticulated, lateral teeth lacking, spiracles vertical; petiole three times as long as wide, surface minutely shagreened, lateral carinae present, basal lamina much wider on ventral than on dorsal side; gaster longer than metafemur, tergites 3 and 4 glabrous, their combined lengths greater than following ones combined, tergites 5 to 8 minutely shagreened, lateral setae present on tergites 4 to 7; eighth tergite uniformly covered with long setae, spiracles oval; cerci large, oval, provided with fine long setae and located near posterior margin of epipygium; a patch of long, stiff setae ventrolaterad of each cercus.

Male: 2 mm. Antennal scape (fig. 9, *g*) broad and stout; width of malar space slightly more than one-third height of compound eye; combined widths of compound eyes equal to width of interocular space at level of antennal bases; diameter of posterior ocellus two-fifths interocellar space; petiole three times as long as wide.

Type locality.—Illinois.

Types.—Holotype, female, Dixon Springs, Ill., July 9, 1935, DeLong and Ross; allotype, male, Falls Church, Va., July 11, 1920, E. A. Chapin; paratypes, Oswego, N. Y., July 1, 1897, 1 male, Champaign, Ill., July 2, 1890, Hart and Marten, 1 female. Holotype and one paratype deposited in Illinois State Natural History Survey collection; allotype and one paratype in the U. S. National Museum.

Host.—Unknown.

SPILOCHALCIS LECTA (Cresson)

FIGURE 9, *f*

Smicra lecta CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 36, 44, 1872.—CAMEBON, Biologia Centrali-Americana, Hymenoptera, vol. 1, p. 94, 1884.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 35, 1885.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 378, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 34, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 75, 1916.

This species is most easily recognized by the head, from the dorsal aspect, being one-half as long as wide, with the scrobe cavity deep, the metacoxa with a completely glabrous outer dorsal surface, the abdominal petiole short, and the abdomen rather strongly compressed. *S. lecta* is quite similar in structure to the genotype, and apparently also to *S. indica* Mani, recently described from India.¹⁶

Description.—Black with large yellow spots; anterior and meso-legs, frons, two large anterolateral areas of dorsum of pronotum, broad anterolateral spots of mesopraescutum, tegulae, all of mesoscutellum except narrow apical band, metatrochanters and metafemora except variable spots on outer surface, yellow.

Female: Unknown.

Male: 4.5–5.5 mm. Antennal scape (fig. 9, *f*) with apex not quite reaching level of ventral margin of anterior ocellus, pedicel slightly longer than segment 4, ring segment one-half length of pedicel, segment 5 slightly shorter than 4, segments 5 to 10 equal, 11 and 12 slightly shorter than 10, 13 equal to 10; scrobe cavity deep, edge carinate at ventral and dorsal margins, dorsal carina located just ventral to anterior ocellus; interantennal projection with a minute dorsal carina; frons deeply but scatteringly punctured laterad of scrobe cavity, ventrad of antennal bases a few irregular transverse carinae present, area laterad of scrobe cavity slightly produced cephalad; frontal tentorial pits located just laterad of antennal bases, slightly above level of ventral margin of scrobe cavity; width of malar space one-third height of compound eye; frontogenal suture arced; genal area posterior to suture with rather indistinct oblique rows of large punctures; combined widths of compound eyes slightly less than interocular width at level of antennal bases; left mandible with two acute teeth, ventral one larger, right mandible with three teeth somewhat blunted at apex, ventral one largest; diameter of posterior ocellus slightly less than one-half interocellar space; head, when viewed from dorsal aspect, slightly greater than one-half as long as wide.

Dorsum of thorax densely and deeply pitted, areas between punctures minutely reticulated; pubescence mostly short, longer at posterior margins of pronotum and mesoscutellum; anterolateral angles of pronotum weakly carinate, anterior dorsal margin acarinate; parapsidal furrows obscure; prepectus narrow, tonguelike, reaching tegula; apex of mesoscutellum provided with a very narrow, mesally depressed lamina; metepisternum strongly and densely punctured, spaces between punctures glabrous, pubescence long and fine; metacoxae glabrous on outer dorsal surface, elsewhere minutely, scatteringly punctured and setose; metafemora globose, outer surface minutely reticu-

¹⁶ Rec. Indian Mus., vol. 37, p. 252, 1935.

lated, densely covered by short setae, ventral margin with 18 to 25 small, closely set teeth, the basal one rounded (as in fig. 12, *k*); inner tooth distinct, blunt.

Propodeum covered with irregular, strong carinae, areas between carinae minutely reticulated, spiracular openings, almost vertical, no lateral propodeal projections present; petiole short, slightly less than twice as long as wide, glabrous on dorsal side, minutely reticulated on lateral and ventral sides, basal lamina narrow, interrupted at dorsolateral angles, distinct lateral carinae present, usually extending from base to apex but sometimes obliterated near apex; gaster compressed, slightly shorter than metafemur, abdominal tergites 4 to 7 with a few lateral setae, eighth tergite minutely shagreened, sparsely setose, spiracular openings oval; cerci large, oval, located near posterior margin of ninth tergite.

Type locality.—Mexico.

Types.—Holotype, male, 1805.1; paratype, 1805.2, 1 male: Academy of Natural Sciences of Philadelphia.

Host.—Unknown.

Distribution.—TEXAS: Brownsville, June, 1 male, November 22–December 8, 1910, 5 males.

MEXICO: Sumichrast, 2 males (holotype and paratype).

SPILOCHALCIS PALLENS (Cresson)

Smiera palens CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 96, 1865.

Smiera pallens CRESSON, The Cresson types of Hymenoptera, p. 76, 1916.

Smiera pallens (Cresson) WALKER, Notes on Chalcididae, p. 51, 1871.—CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 38, 54, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 35, 1885.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 380, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 35, 1909.

Spilochalcis pallens (Cresson) VICKERY, Journ. Econ. Ent., vol. 8, p. 391, 1915; Proc. Ent. Soc. Washington, vol. 27, p. 139, 1925.—LUGIBILL, U. S. Dept. Agr. Techn. Bull. 34, p. 76, 1923.—VICKERY, U. S. Dept. Agr. Techn. Bull. 138, pp. 21, 50, 1929.

This minute, vaguely colored species is closely related to *Spilochalcis xantha*, described below, in having the thorax broad, the anterior margin of the pronotum acarinate, the head nearly one-half as long as wide, and the vertex broadly rounded; it differs in that the dorsum of the thorax is very coarsely (rather than lightly) punctured, the compound eyes and posterior ocelli are almost contiguous, the abdomen is distinctly acuminate (rather than semiglobose), and the basal tooth of the metafemur is acute rather than rounded. *S. pallens* is also slightly smaller and more vaguely marked than *S. xantha*.

Type locality.—Cuba.

Types.—Holotype, female, 1793.1; allotype, male, 1793.3; paratypes, 1793.2, 1793.4, 2 females, Academy of Natural Sciences of Philadelphia.

The allotype is labeled "variety" and may eventually be shown to represent another species.

This species is known to me only from the types, but several references to it have appeared in the North American literature. I have not located the material on which these records were based. Vickery records several experiments performed with this species, and gives a partial life history. *S. pallens* is, like the other members of this genus, a pupal parasite; Vickery described the oviposition in pupae of *Apanteles marginiventris* (Cresson). The males are produced parthenogenetically.

Hosts.—*Meteorus laphygmae* Viereck, *Rogas laphygmae* Viereck, *Apanteles marginiventris* (Cresson) (Hymenoptera, Braconidae) [Vickery].

Distribution.—Cuba, 3 females, 1 male (types).

SPILOCHALCIS XANTHA, new species

This species agrees with *S. subobsoleta* (Cresson) in having the antennal scape short, the flagellum stout, the head, from the dorsal aspect, one-half as long as wide, and the basal tooth of the metafemur rounded instead of acute. It differs from that species in having the scrobe cavity shallow instead of deep, and the outer dorsal surface of the metacoxa glabrous instead of shagreened. Moreover, it is almost entirely yellow, while *S. subobsoleta* is mostly black.

Description.—Yellow with brown or black markings; usually antennal flagellum, occiput, variable short, transverse mark at anterior margin and longitudinal mesal stripe of mesopraescutum, anteromesal areas of lobes of mesoscutum, anterior margins and posterolateral angles of axillae, usually a narrow longitudinal mesal stripe on mesoscutellum, variable marks on mesopleuron, sometimes a vague, round mark on dorsolateral surface of metacoxae, metafemoral teeth, variable basal stains on propodeum, usually most of gaster, black or brown.

Female: 3.5–4 mm. Antennal scape short, apex not quite attaining level of ventral margin of anterior ocellus, pedicel equal in length to segment 6, ring segment with anterior margin oblique instead of transverse so that fourth antennal segment is narrower on mesal side than on outer side, segment 5 slightly shorter than 6, following segments somewhat variable but all subequal; scrobe cavity shallow, margin completely acarinate; interantennal projection produced slightly cephalad, provided with a faint carina near apex; frons lightly shagreened and covered by minute, slightly irregular carinae, these reticulations transverse ventrad of antennal bases, but laterad of scrobe cavity usually directed obliquely; frons with a few short, scattered setae; frontal tentorial pits located at level of antennal bases; width of malar space slightly less than one-quarter height of

compound eye; frontogenal suture straight; combined widths of compound eyes three-quarters width of interocular space at level of antennal bases; left mandible with two teeth, right with three; diameter of posterior ocellus slightly less than one-half width of interocellar space; head, from dorsal aspect, one-half as long as wide.

Dorsum of thorax shagreened and provided with scattered shallow punctures, pubescence sparse; anterolateral angles of pronotum weakly carinate, anterior dorsal margin acarinate; parapsidal furrows distinct; prepectus narrow, apex not quite reaching tegula; mesoscutellum with a narrow apical lamina, which is only slightly depressed on meson; metepisternum provided with deep punctures, areas between punctures glabrous; metacoxae glabrous, pubescent on outer ventral side; metafemora minutely reticulated on outer dorsal area, glabrous ventrad, sparsely setose, ventral margin with 16 to 20 small closely set teeth, basal one rounded (as in fig. 12, *k*); inner tooth acute.

Surface of propodeum provided with small, rather irregular carinae, areas between carinae minutely reticulated, spiracular openings vertical; petiole slightly less than twice as long as wide, glabrous on dorsal side, very lightly shagreened on ventral side, basal lamina wide on ventral and lateral sides, wanting on dorsal side, minute lateral carinae present; gaster usually equal to length of metafemur, very slightly compressed; abdominal segments 4 to 7 each with a single sparse row of lateral setae; eighth tergite lightly shagreened, almost glabrous, spiracular openings round; cerci large, oval, located slightly nearer posterior than anterior margin of epipygium and provided with three setae; apex of ovipositor sheath with a few short ventral setae.

Male: Unknown.

Type locality.—Arizona.

Types.—Holotype, female, Sabino Basin, Santa Catalina Mountains, Ariz., September 5, C. H. T. Townsend; paratypes, Highrolls, N. Mex., May 31, 1902, 1 female; Sabinal, Tex., April 1910, Pierce and Pratt, 1 female; Alice, Tex., February 27, 1909, F. C. Pratt, 1 female. Holotype and two paratypes deposited in the U. S. National Museum; one paratype in Academy of Natural Sciences, Philadelphia.

Host.—Unknown.

SPILOCHALCIS ODONTOTAE Howard

FIGURE 9, *h*

Spilochalcis odontotae HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 7, 1885; Ent. Amer., vol. 1, p. 117, 1885.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 385, 1898.—CHITTENDEN, Remedies for insect pests, p. 4, 1901.—COTTON, Ohio Nurs. and Orch. Insp. Bull. 7, p. 18, 1906.—SCHMIEDEKNECHT, Genera Insectorum, fasc. 97, p. 40, 1909.—SMITH, Ann. Rep. New Jersey State Mus. for 1909, p. 640, 1910.

Smicra odontotae (Howard) CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 234, 1887.

This small, dull-yellow species is most easily recognized by its short antennal scape and stout flagellum, with the ring segment one-half the length of segment 4, the shallow scrobe cavity, the head, from the dorsal aspect, being one-half as long as wide, and a strong carina on the genal area of the head, extending from the base of the mandible to the lateral ocellus.

Description.—Dull yellow with brown markings; all dorsal sutures of thorax, vague mesal stripe near apex of mesopraescutum, broad irregular longitudinal mesal stripe of mesoscutellum, variable areas on pleuron and venter, teeth of metafemur, lateral areas of propodeum, and transverse bands on abdominal tergites 5 to 8, brown; the head of one female specimen is bright red, but another specimen of the same sex has the head yellow.

Female: 3.5 mm. Apex of antennal scape not quite attaining level of ventral margin of anterior ocellus, pedicel one-fourth longer than and ring segment one-half length of segment 4, segments 4 to 10 equal in length and as wide as long, last three segments slightly shorter; scrobe cavity shallow, interantennal projection with a minute dorsal carina; frons laterad and dorsad of scrobe cavity coarsely punctate, area ventrad of antennal bases provided with a few irregular punctures, spaces between punctures minutely reticulated; frontal tentorial pits located near eye margins slightly dorsad of antennal bases; width of malar space one-third height of compound eye; frontogenal suture arched; on gena, a strong carina extends from midpoint of base of mandible around posterior margin of compound eye to posterior ocellus; combined width of compound eyes equal to width of interocular space at level of antennal bases; left mandible with two acute teeth, right with three; diameter of posterior ocellus two-fifths interocellar space.

Dorsum of thorax covered by shallow, irregular punctures, area at anterior margin of mesopraescutum without punctures, but minutely shagreened; pubescence long, dense, white; anterolateral angles of pronotum minutely carinate, anterior dorsal margin acarinate; parapsidal furrows distinct; prepectus narrow, fingerlike, not quite reaching tegula; mesoscutellum with a narrow apical lamina; metepisternum strongly punctured, pubescence long and dense; metacoxae minutely shagreened, shallowly pitted and setose on outer ventral side; metafemur rather slender, outer surface minutely reticulated, densely covered by short setae, ventral margin with 16 to 18 small, acute teeth, basal one slightly larger; inner tooth acute.

Propodeum provided with irregular, strong carinae, areas between carinae almost glabrous, one small lateral projection present at each

posterolateral angle, spiracular slits almost vertical; petiole slender, twice as long as wide, dorsal surface minutely reticulated, almost glabrous, basal lamina slightly wider on ventral than on dorsal side, lateral carinae present; gaster flattened on dorsal surface, slightly longer than metafemur, abdominal tergites 4 to 7 with long lateral setae; eighth tergite minutely reticulated, and provided with long, sparse setae, spiracular openings round; cerci oval, located near posterior margin of epipygium, usually provided with three long setae; apex of ovipositor sheath with a few long ventral setae.

Male: 3 mm. Antennal scape (fig. 9, *h*) short, stout; malar space slightly less than one-third height of compound eye; combined widths of compound eyes equal to width of interocular space at level of antennal bases; petiole two and one-half times as long as wide; gaster shorter than metafemur.

Type locality.—Washington, D. C.

Type.—Holotype, male, 2624, U. S. National Museum.

Host.—*Chalepus dorsalis* Thunberg [= *Odontota scutellaris* (Olivier)] (Coleoptera, Chrysomelidae).

Distribution.—DISTRICT OF COLUMBIA: Washington, July 31, 1884, 3025^{os}, 1 male (holotype); August 12, 1884, 3025^{os}, 1 female, 1 male; all three specimens reared from *Chalepus dorsalis* mining leaves of *Robinia pseudoacacia*. NORTH CAROLINA: Tin City, July 10, 1934, F. S. Blanton, 1 female.

SPILOCHALCIS SUBOBSOLETA (Cresson)

FIGURES 9, *i*; 12, *k*

Smicra subobsoleta CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 36, 42, 191, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 36, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 234, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 382, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 36, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 76, 1916.

Smicra bioculata CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 36, 43, 192, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 33, 1885.—ASHMEAD, Trans. Amer. Ent. Soc., vol. 13, p. 125, 1886.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 374, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 34, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 74, 1916.

Spilochalcis bioculata (Cresson) VIERECK, Trans. Amer. Ent. Soc., vol. 32, p. 184, 1906.

Smicra bioculata faceta CRESSON, Trans. Amer. Ent. Soc., vol. 4, p. 43, 1872; Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 374, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 34, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 75, 1916.

This species is most easily recognized by its compact body, with the antennal scape short and flagellum stout, the head, from the dorsal aspect, one-half as long as wide, the metafemora semiglobose and with 18 or more minute ventral teeth, the basal one rounded, not acute (fig. 12, *k*), and the abdomen strongly compressed.

Description.—Black with yellow markings; anterior and mesolegs, frons, all dorsal area of pronotum except narrow mesal spot, broad, wedge-shaped lateral spots of mesopraescutum, tegulae, lobes of mesoscutum except variable longitudinal mesal mark, usually small ventral spot at apex of metacoxa, basal and variable dorsal and apical spots of metafemur, yellow; abdomen varying from black to rufous.

Female: 4–4.5 mm. Apex of antennal scape not quite reaching level of ventral margin of anterior ocellus, pedicel slightly longer than segment 4, ring segment one-half length of pedicel, segments 4 to 11 equal in length, 12 and 13 slightly shorter; scrobe cavity deep, edge indistinctly carinate at dorsal and ventral margins, several indistinct transverse carinae usually present in scrobe cavity just ventrad of anterior ocellus; interantennal projection with a minute dorsal carina; deep, closely set punctures on frons lateral to scrobe cavity, punctures scattered ventrad of antennal bases, tending to coalesce to form irregular transverse carinae; frontal tentorial pits located just laterad of scrobe cavity, at level of ventral margin; width of malar space one-third height of compound eye; frontogenal suture for one-half its length extending directly ventrad from compound eye, then abruptly curved toward mandible; area of gena posterior to frontogenal suture usually with three oblique rows of large punctures; combined widths of compound eyes slightly more than one-half interocular width at level of antennal bases; left mandible with two acute teeth, the ventral one larger, right mandible with three teeth, the middle one smallest and most blunt; diameter of posterior ocellus slightly less than one-half interocellar width.

Dorsum of thorax densely and coarsely pitted, areas between punctures minutely reticulated; pubescence short except at posterior dorsal margin of pronotum and on mesoscutellum; anterolateral angles of pronotum weakly carinate, dorsal anterior margin acarinate; parapsidal furrows obscure; prepectus narrow, tongue-shaped, slightly overlapping anterior apex of tegula; apex of mesoscutellum provided with a narrow, mesally depressed lamina; metepisternum deeply and closely punctured; metacoxae minutely shagreened on outer dorsal surface, strongly punctured and setose elsewhere; metafemora globose, outer surface minutely reticulated, ventral margin with 18 to 26 small, closely set teeth, basal one rounded, not acute (fig. 12, *k*); inner tooth large, usually acute; metatibia with apex acute or blunt.

Propodeum thickly covered by irregular, closely set carinae, areas between carinae minutely reticulated, lateral propodeal projections wanting, spiracular openings nearly vertical; petiole short, less than twice as long as wide, minutely shagreened on dorsal side near base, slightly more strongly shagreened on lateral and ventral sides, basal lamina narrow, strong lateral carinae present; gaster compressed, usually somewhat shorter than metafemur, abdominal tergites 4 to 7 with lateral setae; eighth tergite minutely shagreened, sparsely covered by long setae, spiracular openings round; cerci oval, located slightly nearer anterior than posterior margin of epipygium; apex of ovipositor sheath with a dense tuft of long ventral setae.

Male: 4.5–5.5 mm. Antennal scape (fig. 9, *i*) stout, sinuate; width of malar space one-fourth height of compound eye; combined widths of compound eyes two-thirds width of interocular space at level of antennal bases; inner tooth of metafemur blunt; petiole varying from slightly more than one-third to one-half as wide as long.

Type locality.—Texas.

Types.—Holotype, male, 1436, U. S. National Museum. The female was described as *Smicra bioculata* Cresson, from Texas; types: *bioculata* Cresson, 1784, Academy of Natural Sciences of Philadelphia, and 1652, U. S. National Museum; *bioculata faceta* Cresson, 1653, U. S. National Museum.

The types of *S. subobsoleta* Cresson and *S. bioculata* Cresson show distinct color differences, but intermediates between the two are readily found; they differ structurally in that *bioculata* has the apex of the metatibia rather blunt, while it is acute in *subobsoleta*. All variations between these two extremes were found in the material secured for study, and one specimen was found which had one tibia acute and the other blunt. The type of *S. bioculata faceta* has the yellow spots very light, but is otherwise identical with the typical form of this species.

Host.—Unknown.

Distribution.—Colorado, Florida, Illinois, Iowa, Kansas, Montana, North Dakota, South Dakota, Texas, Wyoming.

SPILOCHALCIS PALLIPES (Smith)

FIGURE 9, *j*

Chalcis flavipes ASHMEAD (not Panzer), Trans. Amer. Ent. Soc., vol. 12, p. xi, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 234, 1887.

Chalcis pallipes SMITH, Ent. Amer., vol. 2, p. 19, 1886.

Chalcis pallidipes DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 391, 1898.

Smicra flavipes (Ashmead) DALLA TORRE, *ibid.*, p. 377.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 35, 1909.

This species is known to me only from the type, a single male specimen collected in Jacksonville, Fla., by W. H. Ashmead, and another specimen collected in the same city by Mrs. A. T. Slosson. Both specimens are, unfortunately, in very poor condition, but they show a few slight characters that serve to distinguish them from *S. subobsoleta* (Cresson), which they closely resemble. Larger series of specimens will probably show that these differences are not of specific value, but, as no intergrades have as yet been found, it is better to consider these specimens as representatives of a distinct species.

Description.—Male: 3.5 mm. Identical in all respects with the male of *S. subobsoleta* (Cresson) except in the following particulars: Dorsum of thorax entirely black, without any color spots; antennal scape (fig. 9, *j*) short and stout; frontal tentorial pits located at level of ventral margin of scrobe cavity, midway between antennal bases and anterior margins of compound eyes; width of malar space slightly less than one-third height of compound eye; area of gena caudad of frontogenal suture provided with short, irregular carinae and minute reticulations; combined widths of compound eyes three-fourths width of interocular space at level of compound eyes; diameter of posterior ocellus slightly less than one-third width of interocellar space; apex of mesoscutellum provided with a narrow lamina which is only very slightly depressed on meson; apex of metatibia acute; no lateral projections present on propodeum; petiole one-half as long as wide, glabrous on dorsal side.

Female: Unknown.

Type locality.—Florida.

Type.—Holotype, male, 51946, U. S. National Museum.

Host.—Unknown.

Distribution.—FLORIDA: Jacksonville, W. H. Ashmead, 1 male (holotype); Mrs. A. T. Slosson, 1 male.

The side Group

The *side* group of species comprises the most distinct section of the genus *Spilochalcis*. These species are all small or minute, predominantly black, and provided with small, irregular color spots. The lack of a frontogenal suture and the malar space being almost always one-half or more the height of the compound eye will most readily distinguish these species, but, in addition, they always have the clypeus nearly as long as wide, and possess an extremely shallow scrobe cavity. All have two teeth on the left mandible and three on the right, and the reticulations of the body are minute and irregular, with glabrous surfaces almost completely absent. An inner tooth is always present on the metafemora, and the outer ventral teeth are numerous and minute.

There is invariably a row of four or six small, round colored spots along the anterior dorsal margin of the pronotum, although these markings are rather indistinct in some specimens.

This group is clearly related to some species of the *femorata* group; several, such as *S. hirtifemora* (Ashmead) and *S. elachis*, new species, are excluded from this group and placed in the *femorata* group only by the possession of a frontogenal suture and a somewhat narrower malar space. More than half the material of Chalcidini I have obtained for study has been specimens referable to the *side* group. Some of the species in this group are parasites of insect pests, and numerous references to them have appeared in the economic literature. It has been possible to secure for study much of the material on which these references were based. As the types for these species have not, so far as I know, been studied before, it is not surprising that misidentifications should have occurred. Specific differences in this group are much more critical than in the other groups of the genus, and the "habitus" of all the species is quite similar.

The color pattern of all species in this group is fundamentally the same. Hence, a generalized color description is given here for all the species of the group. This applies, with slight discrepancies, to all the species.

Color description.—Black with small, variable greenish-white, red, or yellow spots: mandibles, variable spots on frons, two mesal and four lateral spots on dorsal side of pronotum, anterolateral angles of mesopraescutum, and scutum, large lateral spots on mesoscutellum, variable ventral, basal, and apical spots on outer surface of meta-femur, usually a lateral row of two to six spots on each side of gaster, greenish white, red or yellow; abdominal segments 3 to 5 of female often dull red. Teneral specimens are rufous instead of black.

KEY TO SPECIES OF THE SIDE GROUP

1. Male, ninth abdominal sternite exposed, antennal scape broad..... 2
 Female, ninth abdominal sternite concealed, antennal scape
 narrow 8
2. Mesopraescutum with two rounded, impunctate anterior eleva-
 tions..... *dema* (p. 330)
 Mesopraescutum with surface uniformly covered with large
 punctures, surface not elevated..... 3
3. Antennal scape extremely stout, with a prominent, darkened
 anterior carina (fig. 9, *l*), apex exceeding level of vertex..... 4
 Antennal scape more slender, without a darkened anterior car-
 ina (fig. 9, *m-o*), apex not exceeding level of vertex..... 5
4. Antennae inserted dorsad of ventral margins of compound eyes,
 malar space less than two-thirds height of compound eye;
 basal lamina of petiole forming a 60° to 70° angle with dorsal
 surface of petiole (as in fig. 13, *f*)..... *sanguineiventris* (p. 335)

- Antennae inserted on a level with ventral margins of compound eyes; malar space more than three-quarters height of compound eye; basal lamina of petiole at a right angle to dorsal surface of petiole (as in fig. 13, 4)----- *flavopicta* (p. 331)
5. Entire area of frons laterad and ventrad of scrobe cavity yellow or whitish; diameter of lateral ocellus greater than width of area between lateral ocellus and inner margin of compound eye----- *leptis* (p. 340)
- Not having that combination of characters-----6
6. A small glabrous patch present in scrobe cavity just dorsad of each antennal base-----7
- Scrobe cavity lacking glabrous areas----- *delumbis* (p. 342)
7. Frons with a circumflex-shaped yellow mark just dorsad of mouth parts: a small dark brown or black area present just dorsad of clypeus----- *albifrons* (p. 339)
- Entire frons ventrad of antennal bases yellow; area just dorsad, of clypeus yellow----- *side* (p. 336)
8. Mesopraescutum with two round, impunctate anterior elevations----- *dema* (p. 330)
- Mesopraescutum with surface uniformly covered by large punctures, surface not elevated-----9
9. Maximum dorsal length of epipygium greater than length of eighth tergite (ratios varying from 14:9 to 12:9)--- *flavopicta* (p. 331)
- Maximum dorsal length of epipygium equal to or less than length of eighth tergite-----10
10. Antennae inserted dorsad of ventral margins of compound eyes; width of interantennal space equal to or greater than width of space between antennal fossa and compound eye; frons possessing a pair of vertical foveae ventrad of antennal bases; clypeus one and one-half times as wide as long.----- *sanguineiventris* (p. 335)
- Not having that combination of characters-----11
11. Diameter of posterior ocellus greater than width of space between ocellus and margin of compound eye; antennal flagellum dark on dorsal side and light ventrad----- *leptis* (p. 340)
- Diameter of posterior ocellus less than width of space between ocellus and margin of compound eye; antennal flagellum uniform in color-----12
12. Propodeum with two basolateral areas shagreened, these areas surrounded by strong, confused carinae; coxal flange at apex of metepisternum smooth-----13
- Propodeum entirely rugose, not having basolateral shagreened areas; coxal flange at apex of metepisternum with two or three minute carinae parallel with margin----- *delumbis* (p. 342)
13. Tergites at base of gaster rufous or red; each tergite of gaster usually with a pair of lateral yellow spots----- *side* (p. 336)
- All abdominal tergites black; usually only basal and apical tergites of gaster with lateral yellow spots----- *albifrons* (p. 339)

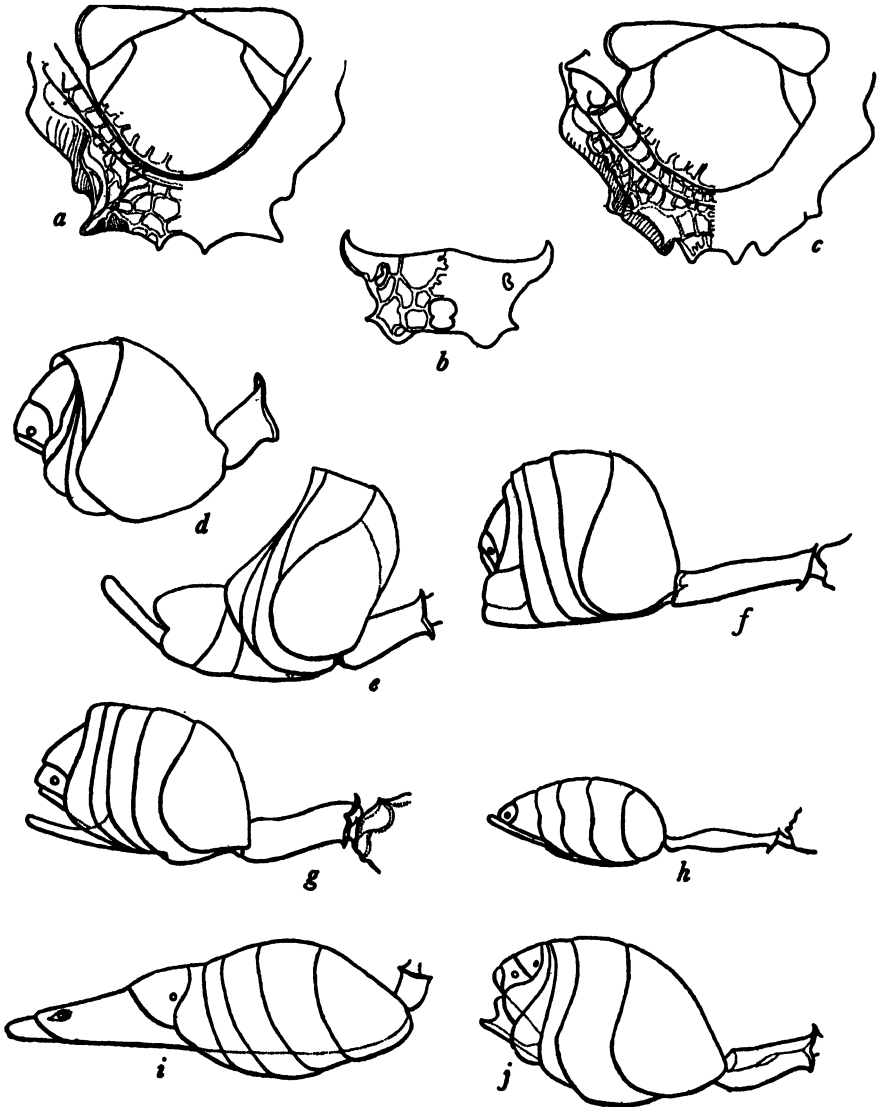


FIGURE 13.—Abdominal structures of Chalcidini.

- a*, *Spilochalcis nigricornis* (Fabricius): Propodeum, dorsal aspect.
b, *Spilochalcis delicata* (Cresson): Propodeum, posterior aspect.
c, *Spilochalcis nortoni* (Cresson): Propodeum, dorsal aspect.
d, *Spilochalcis xanthostigma* (Dalman): Petiole and gaster, lateral aspect.
e, *Chalcis myrifex* (Sulzer): Petiole and gaster, lateral aspect.
f, *Chalcis microgaster* Say: Petiole and gaster, lateral aspect.
g, *Chalcis barbara* (Cresson): Petiole and gaster, lateral aspect.
h, *Ceratosmicra meteori*, new name: Petiole and gaster, lateral aspect.
i, *Spilochalcis dema*, new species: Petiole and gaster, lateral aspect.
j, *Metadontia amoena* (Say): Petiole and gaster, lateral aspect.

SPILOCHALCIS DEMA, new species

FIGURES 9, *k*; 13, *i*; 14, *i**Spilochalcis* sp. MONTGOMERY, Can. Ent., vol. 65, p. 187, 1933.

This species is most closely related to *S. flavopicta* (Cresson), but the female differs in that the malar space is nearly as wide as the height of the compound eye, not one-half as wide, the thorax is wider and more compact with two round, impunctate elevations on the mesopraescutum, and the longitudinal dorsal length of the epipygium of the female is twice as great as the length of the eighth tergite (fig. 13, *i*). The males of the two species differ most conspicuously in that the male of *flavopicta* has the antennal scape extremely large (fig. 9, *l*), while it is quite narrow in this species (fig. 9, *k*).

Description.—Male: 3–5.5 mm. Antennae inserted at level of ventral margins of compound eyes, apex of scape slightly exceeding level of ventral margin of anterior ocellus, pedicel four-fifths and ring segment one-fifth length of segment 4, 5 equal to pedicel, segments 5 to 9 equal in length, 10 very slightly shorter, 11 one-sixth shorter than 9, 12 and 13 equal and shorter than 11, scrobe cavity shallow, edge indistinctly carinate at ventral margin; interantennal projection wide, without an apical lamina; frons shagreened over entire surface, sparsely covered by rather long setae; width of malar space three-fourths height of compound eye; combined widths of compound eyes two-thirds width of interocular space at level of apex of interantennal projection; left mandible with two equal, acute teeth, right mandible with three, the dorsal one slightly larger; diameter of posterior ocellus two-fifths width of interocellar space.

Dorsum of thorax minutely shagreened, provided with large pits except on two rounded anterolateral areas of mesopraescutum; posterolateral angles of pronotum produced in small, rounded projections; prepectus narrow, fingerlike, slightly overlapping anterior apex of tegula; apex of mesoscutellum provided with a very narrow, mesally depressed lamina; metepisternum deeply, scatteringly pitted, areas between pits minutely shagreened, pubescence short; metacoxae minutely shagreened over entire surface, punctured and setose except on outer dorsal surface; metafemora globose, outer surface minutely shagreened, thinly covered by short setae, outer ventral margin with 18 to 23 small, closely set teeth, basal one slightly larger; inner tooth large, blunt.

Dorsal surface of propodeum strongly carinate except on two basolateral areas, the latter covered by small confused reticulations, a small apical projection present on each side of point of insertion of petiole, spiracular slits slightly curved laterad; petiole short, only slightly longer than wide; minutely shagreened and with distinct lateral carinae, basal lamina narrow; gaster usually equal in length

to metafemur, abdominal tergites 4 to 7 with rows of lateral setae; eighth tergite minutely shagreened, sparsely covered by moderately long setae, spiracular openings round; cerci oval, located near posterior margin of ninth tergite.

Type locality.—Indiana.

Types.—Holotype, female, Bedford, Ind., August 31, 1931, ex *Gelechia nundinella*; allotype, male, Bedford, Ind., September 9, 1931, ex *Gelechia nundinella*; paratypes, Bedford, Ind., August 15–September 24, 1931, ex *Gelechia nundinella*, 7 females, 5 males; Lawrence County, Ind., June 23, 1933, ex *Gelechia nundinella*, Musgrave, 3 females; Alamogordo, N. Mex., May 9, 1902, 1 female; Atherton, Mo., May 15, 1922, C. F. Adams, 1 female. Holotype, seven female and five male paratypes deposited in the U. S. National Museum; three paratypes in the Illinois State Natural History Survey collection; one paratype, Academy of Natural Sciences of Philadelphia, and one paratype, University of Kansas, Lawrence, Kans.

Host.—*Gelechia nundinella* Zeller (Lepidoptera, Gelechiidae).

SPILOCHALCIS FLAVOPICTA (Cresson)

FIGURES 7, e; 9, l; 14, f

Smicra flavopicta CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 99, 1865.—CRESSON, The Cresson types of Hymenoptera, p. 75, 1916.

Smicra flavopicta (Cresson) WALKER, Notes on Chalcididae, p. 51, 1871.—CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 36, 41, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 34, 1885.—ASHMEAD, Trans. Amer. Ent. Soc., vol. 13, p. 125, 1886.—CRESSON, Synopsis of the families and genera of Hymenoptera of America north of Mexico, p. 233, 1887.—ASHMEAD, Trans. Amer. Ent. Soc., vol. 14, p. 183, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 337, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 35, 1909.

Sptlochalcis sp. PIERCE, Journ. Econ. Ent., vol. 1, p. 382, 1908.—PIERCE ET AL., U. S. Dept. Agr. Bur. Ent. Bull. 100, pp. 41, 49, 1912.—HUNTER and PIERCE, U. S. Dept. Agr. Bur. Ent. Bull. 114, p. 141, 1912.—MITCHELL and PIERCE, Proc. Ent. Soc. Washington, vol. 13, p. 55, 1912.

Smicra deltra CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 36, 41, 191, 1872.—ASHMEAD, *ibid.*, vol. 12, p. x, 1885.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 34, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 375, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 34, 1909.

Sptlochalcis deltra (Cresson) HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 7, 1885.—VIERECK, Trans. Amer. Ent. Soc., vol. 32, p. 184, 1906.—SMITH, Ann. Rep. New Jersey State Mus. for 1909, p. 649, 1910.—BOTTIMER, Journ. Agr. Res., vol. 33, p. 803, 1926.—CUSHMAN, *ibid.*, vol. 34, p. 620, 1927.

Smicra decempunctata ASHMEAD, Trans. Amer. Ent. Soc., vol. 9, p. xxix, 1881.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 34, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 375, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 34, 1909.

Smicra mendica CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 36, 41, 1872.—CAMERON, Biologia Centrali-Americana, Hymenoptera, vol. 1, p. 94, 1884.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 35, 1885.—ASHMEAD, Trans. Amer. Ent. Soc., vol. 14, p. 183, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 379, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 35, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 75, 1916.

This species is most easily recognized, in the female, by the longitudinal dorsal length of the epipygium being one and one-half times the length of the eighth tergite; the male has an extremely stout antennal scape which is inserted on a level with the ventral margins of the compound eyes, and the apex exceeds the level of the posterior ocelli.

Description.—Male: 3.5 mm. Antennae inserted on a level with ventral margins of compound eyes (fig. 7, *e*), apex of scape exceeding level of vertex, pedicel four times as long as and ring segment one-half length of segment 4, segments 5 and 6 equal to or slightly longer than 4, 7 to 10 progressively longer, so that 10 is one-half longer than 4, last three slightly shorter; scrobe cavity shallow, margin entirely without carinae, or with a very indistinct ventral one, a glabrous area just laterodorsad of each antennal base; interantennal projection broad, usually with a minute dorsal carina; frons covered by minute reticulations over entire surface, reticulations forming vague, minute parallel carinae on area laterad of scrobe cavity; width of malar space three-fourths or more height of compound eye; combined widths of compound eyes one-fifth less than width of interocular space at level of apex of interantennal projection; left mandible with two blunt teeth, right mandible with three acute teeth; diameter of posterior ocellus slightly less than one-half width of interocellar space.

FIGURE 14.—Male terminalia of Chalcidini.

- a*, *Chalcis divisa* (Walker): Ninth sternite.
- b*, *o*, *Chalcis lasia*, new species: *b*, Ninth sternite; *o*, male genitalia (*Oe*, aedeagus; *Sag*, sagitta; *Sh*, ovipositor sheath).
- c*, *Chalcis neptis*, new species: Ninth sternite.
- d*, *Chalcis flebilis* (Cresson): Ninth sternite.
- e*, *Chalcis barbara* (Cresson): Ninth sternite.
- f*, *Chalcis canadensis* (Cresson): Ninth sternite.
- g*, *Chalcis microgaster* Say: Ninth sternite.
- h*, *Podagrion mantis* Ashmead: Terminal abdominal segments, lateral aspect. (*C*, cercus; *Oe*, aedeagus; *Sp*, spiracle.)
- i*, *Spilochalcis dema*, new species: Penis valve.
- j*, *Spilochalcis flavopicta* (Cresson): Penis valve.
- k*, *Spilochalcis sanguineiventris* (Cresson): Penis valve.
- l*, *Spilochalcis side* (Walker): Penis valve.
- m*, *Spilochalcis leptis*, new species: Penis valve.
- n*, *Spilochalcis delumbis* (Cresson): Penis valve.

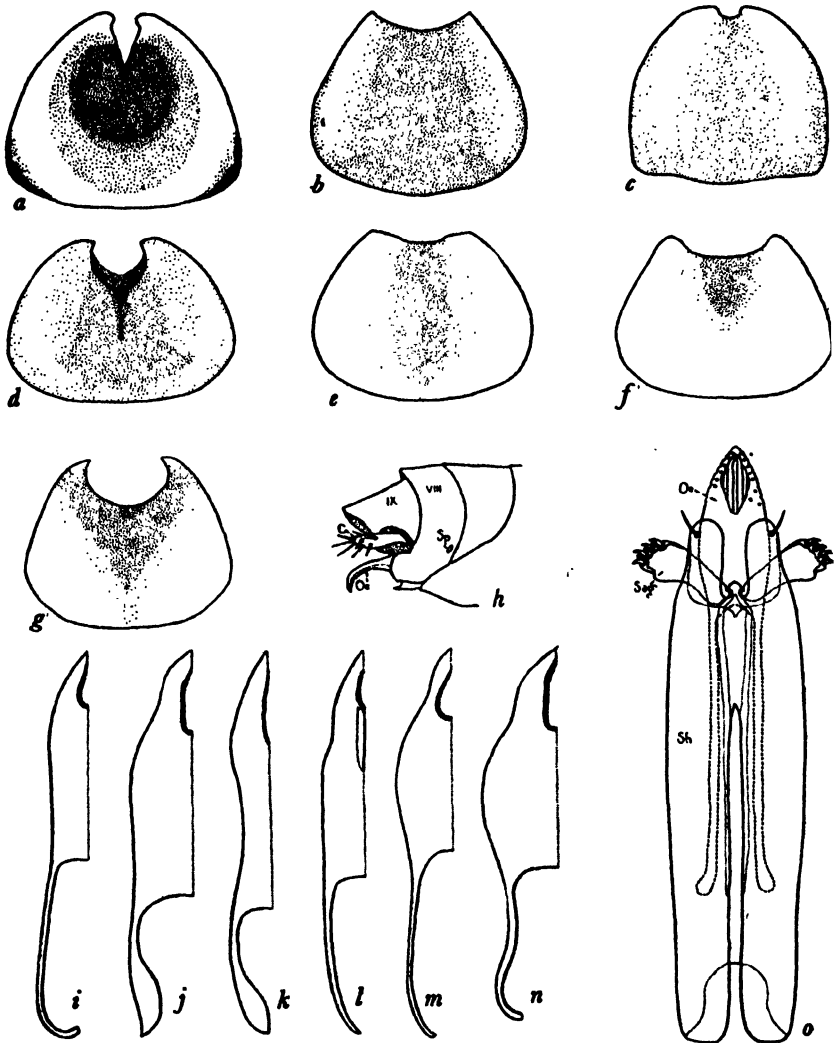


FIGURE 14.—See opposite page for explanation.

Dorsum of thorax closely and irregularly pitted, pubescence scattered, fine, slightly longer and thicker at posterior margins of mesopraescutum and axillae, and lateral and posterior margins of mesoscutellum; anterolateral and sublateral angles of pronotum produced, rounded, anterior dorsal margin acarinate; parapsidal furrows well defined; prepectus narrow, apex blunt, extending to tegula; apex of mesoscutellum with a mesally depressed, narrow lamina; metepisternum strongly and densely punctured, provided with only scattered fine setae; metacoxa shagreened on outer dorsal surface, lightly pitted and pubescent on ventral side; metafemur minutely reticulated, provided with short pubescence, ventral margin with 18 to 22 small, closely set teeth, the basal one slightly larger; inner tooth acute or slightly blunted.

Propodeum strongly carinate on meson and at apex, two large, minutely reticulated lateral areas at base, a pair of minute projections at lateroventral angles of propodeum, spiracular openings slanting slightly laterad; petiole twice as long as wide, entire surface shagreened, basal lamina narrow, from lateral aspect, appearing to be at right angles to dorsum of petiole, indistinct lateral carinae present; abdominal segments 4 to 7 each with a pair of dorsolateral patches of setae; eighth tergite minutely reticulated, provided with sparse, fine setae, spiracular openings oval; cercus located near apex of ninth tergite, usually provided with three long setae; penis valve (fig. 14, j).

Type locality.—Cuba.

Types.—Holotype, female, 1810, Academy of Natural Sciences of Philadelphia. The male was described as *Smicra delira* Cresson from Texas; type, 1655, U. S. National Museum. Synonyms: *decempunctata* Ashmead, 51945, U. S. National Museum; *mendica* Cresson, 1802, Academy of Natural Sciences of Philadelphia.

Reared materials have shown that *S. flavopicta* Cresson, described from Cuba, and *S. delira* Cresson, described from Texas, are the sexes of the same species. The type of *S. decempunctata* Ashmead, described from Florida, differs neither in color nor in structure from the type of *S. flavopicta* Cresson. The type of *S. mendica* Cresson, a male from Mexico, differs from the type of *S. delira* Cresson only in being slightly smaller, lighter in color, and having the darkened anterior carina of the antennal scape extending almost to the base, rather than only one-half the distance from the apex to the base; intergrades for all these characters are present in the available material.

Hosts.—*Ancylis comptana* Froehlich, *Evetria frustrana* Comstock (Lepidoptera, Eucosmidae); *Homoeosoma electellum* Hulst, *Acrobasis* sp. (Pyralidae); *Phalonia* sp. (Phaloniidae). A single male was found dead inside a cotton boll, along with the remains of a pupa

of *Anthonomus grandis* Boheman (Coleoptera, Curculionidae), and another single male was reared in Texas from an unidentified (probably dipterous) gall.

Distribution.—Alabama, Arizona, California, Delaware, Florida, Georgia, Maryland, Mississippi, New Mexico, North Carolina, Oregon, South Carolina, Texas, Virginia.

Cuba, Mexico.

SPILOCHALCIS SANGUINEIVENTRIS (Cresson)

FIGURE 14, *k*

Smicra sanguineiventris CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 36, 43, 191, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 35, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 234, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 381, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 36, 1909.
Spilochalcis sp. CHITTENDEN and RUSSELL, U. S. Dept. Agr. Bur. Ent. Bull. 66, p. 63, 1909.

The male of this species resembles that of *S. flavopicta* (Cresson) in having the antennal scape extremely large (as in fig. 9, *l*) with the apex exceeding the level of the vertex, but differs in that the malar space is less than two-thirds the height of the compound eye, the petiole has the basal flange, from the lateral aspect, appearing to be at an angle of 60° to 70°, not at 90°; in both *flavopicta* and this species, the proximal, nonfused part of the penis valve is short and stout, but it is somewhat more rounded in this species (fig. 14, *k*), and the distal portion is slenderer in this species than in *flavopicta*. The female of *sanguineiventris* is the only one of the *side* group having the antennae inserted dorsad of the ventral margins of the compound eyes, and the epipygium, which is equal to or shorter than the eighth tergite, will separate it from the female of *flavopicta*.

Description.—Male: 2.5–4 mm. Antennal scape stout, exceeding level of posterior ocelli, pedicel twice as long, and ring segment one-third as long as segment 4, segments 4 to 10 equal, last three shorter, sutures obscured by long, moderately dense setae; scrobe cavity shallow, margin acarinate, a glabrous patch present just dorsolaterad of each antennal base; width of malar space varying from three-fifths to almost two-thirds height of compound eye; combined widths of compound eyes three-fourths interocular space at level of apex of interantennal projection; diameter of posterior ocellus one-third interocellar space; width of head, from dorsal aspect, usually equal to maximum dorsal width of thorax.

Prepectus completely concealed by projecting angle of mesoscutum; apex of mesoscutellum with a minute, mesally depressed lamina; metopisternum irregularly pitted, ventral pits larger than dorsal ones;

metacoxae uniformly shagreened, outer surface with shallow pits and short pubescence; outer surface of metafemora lightly shagreened and sparsely covered with short pubescence, ventral margin with 17 to 20 teeth, basal one slightly larger; small, blunt inner tooth present.

Propodeum shagreened, strongly carinate only laterad, a minute tooth present at each posterolateral angle, spiracles curved laterad; petiole two to two and one-half times as long as wide, surface shagreened, lateral carinae vague or wanting entirely; gaster slightly longer than metafemur; eighth tergite sparsely setose; spiracles oval, almost round; cerci circular or slightly oval, placed near apex of ninth tergite; penis valve short and narrow (fig. 14, *k*).

Type locality.—Texas.

Type.—1658, U. S. National Museum, female.

Hosts.—(?) *Prodenia eridania* Cramer (Lepidoptera, Noctuidae); *Exema conspersa* (Mannerheim) (Coleoptera, Chrysomelidae).

Distribution.—Florida, Georgia, Texas, Virginia.

SPILOCHALCIS SIDE (Walker)

FIGURES 9, *m*; 14, *l*

- Smicra side* WALKER, Ann. Soc. Ent. France, ser. 1, vol. 2, p. 145, 1843.—CRESSON, Proc. Ent. Soc. Philadelphia, vol. 1, p. 228, 1862.
- Smicra side* (Walker) WALKER, Notes on Chalcidiae, p. 51, 1871.—CRESSON, Trans. Amer. Ent. Soc., vol. 4, p. 55, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 36, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 234, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 381, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 36, 1909.
- Smicra torvina* CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 36, 40, 191, 1872.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 36, 1885.—ASHMEAD, Trans. Amer. Ent. Soc., vol. 13, p. 125, 1886.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 234, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 383, 1898.—SMITH, Ann. Rep. New Jersey State Board Agr., vol. 27, suppl., p. 554, 1900.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 36, 1909.—CRESSON, The Cresson types of Hymenoptera, p. 76, 1916.—CHITTENDEN, U. S. Dept. Agr. Dept. Bull. 914, p. 1, 1920.—HOUGH, Virginia Agr. Exp. Stat. Bull. 259, p. 18, 1927.
- Spilochalcis torvina* (Cresson) TITUS, U. S. Dept. Agr. Bur. Ent. Bull. 54, p. 39, 1905.—VIERECK, Trans. Amer. Ent. Soc., vol. 32, pp. 184, 221, 227, 1906.—SNOW, Trans. Kansas Acad. Sci., vol. 20, p. 129, 1907.—SMITH, Ann. Rep. New Jersey State Mus. for 1909, p. 649, 1910.—VIERECK, Connecticut Geol. and Nat. Hist. Surv. Bull. 22, p. 527, 1916.—CHITTENDEN, U. S. Dept. Agr. Dept. Bull. 914, p. 11, 1920.—GIRAULT, Proc. U. S. Nat. Mus., vol. 53, p. 192, 1920.—VICKERY, Proc. Ent. Soc. Washington, vol. 27, p. 139, 1925.—PETCH and ARMSTRONG, Ann. Rep. Quebec Soc. Prot. Plants, No. 18, p. 104, 1926.—MUESERBECK and DOHANIAN, U. S. Dept. Agr. Dept. Bull. 1478, p. 19, 1927.—LUGINBILL, U. S. Dept. Agr. Techn. Bull. 34, p. 77, 1928.—VICKERY, U. S. Dept. Agr. Techn. Bull. 138, p. 21, 1929.—GILLESPIE, Maine For. Serv. Bull. 7, p. 15, 1932.—KEIFER and JONES, California Dept. Agr. Monthly Bull. 22, p. 388, 1933.—DOWER, Ann. Ent. Soc. Amer., vol. 29, p. 234, 1936.

- Smicra tourina* SMITH, Geol. Surv. New Jersey, Catalogue of insects, p. 38, 1880.
Smicra delira CHITTENDEN, U. S. Dept. Agr. Dept. Bull. 914, p. 11, 1920.—HOUGH,
 Virginia Agr. Exp. Stat. Bull. 259, p. 18, 1927. (Misidentifications.)
Spilochalcis delira VICKERY, Journ. Econ. Ent., vol. 8, p. 391, 1915.—MARCH, Journ.
 Agr. Res., vol. 10, p. 1, 1917.—OTAVES and SISON, Philippine Agr. Rev., vol. 20,
 p. 251, 1927.—VICKERY, U. S. Dept. Agr. Techn. Bull. 138, p. 32, 1929.—NETTLES,
 Journ. Econ. Ent., vol. 27, p. 816, 1934. (Misidentifications.)
Spilochalcis sp. UNDEHILL, Virginia State Crop Pest Comm. Quart. Bull. 6,
 p. 6, 1924.—CUSHMAN, Journ. Agr. Res., vol. 34, pp. 619, 622, 1927.—FINK,
ibid., vol. 44, p. 555, 1932.

This common species is most easily recognized in the male by the broadly rounded vertex, the antennae inserted slightly dorsad of the ventral margins of the compound eyes, with the apex of the scape not exceeding the level of the posterior ocelli, the elongate pedicel (fig. 9, *m*) and the entire frons ventrad of the antennal bases being yellow. The female is recognized by its broadly rounded vertex, the basolateral areas of the propodeum being shagreened rather than carinate, and the basal tergites of the gaster rufous or red.

Description.—Male: 3–4 mm. Antennae inserted slightly dorsad of ventral margins of compound eyes, scape (fig. 9, *m*) not exceeding level of posterior ocelli, pedicel always at least one and one-half times as long as segment 4, often nearly twice as long, ring segment one-half length of segment 4, flagellar segments variable, 4 to 7 usually equal, 8 to 12 slightly longer, 13 equal to 7; scrobe cavity shallow, margin acarinate, a glabrous spot present in scrobe cavity just dorsad of each antennal base; frons minutely shagreened, provided with conspicuous white pubescence; interantennal projection minutely carinate; malar space one-half height of compound eye; left mandible with two acute teeth, right with three; combined widths of compound eyes equal to or slightly greater than interocular width at level of antennal bases; diameter of posterior ocellus slightly more than one-third width of interocellar space.

Dorsum of thorax shallowly and irregularly pitted, areas around parapsidal furrows impunctate; pubescence stout, white; anterolateral angles of pronotum slightly produced; anterior dorsal margin acarinate; prepectus narrow, reaching tegula; apex of mesoscutellum provided with a narrow, mesally depressed lamina; metepisternum shagreened, surface provided with large shallow punctures; metacoxae shagreened on outer dorsal side, obscurely punctured and setose on outer ventral surface; metafemora minutely reticulated, sparsely covered with short setae; outer ventral margin with 14 to 18 minute teeth, basal one larger and slightly blunted; small inner tooth present.

Propodeum usually entirely without setae, a few sometimes present at sides, surface shagreened, mesal and apical carinae present, a minute lateral projection at each posterolateral angle, spiracular

openings oblique; petiole shagreened, three to three and one-half times as long as wide, basal lamina narrow, lateral carinae usually wanting, sometimes vaguely indicated near base; gaster slightly longer than metafemur; abdominal segments 4 to 7 with a few sparse lateral setae; eighth tergite obscurely shagreened, provided with a few slender setae; spiracles oval; cerci obovate, located near posterior margin of ninth tergite; penis valve (fig. 14, *l*).

Type locality.—Florida.

Type.—Holotype, female, British Museum; comparisons made by Dr. Ch. Ferrière. Types for the synonym: *torvina* Cresson, 1871, U. S. National Museum, and 1780, Academy of Natural Sciences of Philadelphia.

As can be seen from the host list given below, this species has been reared from a number of diverse Lepidoptera, Coleoptera, and parasitic Hymenoptera. It has been reared as a primary and secondary parasite. It would seem doubtful that the forms reared from all these hosts should belong to the same species, although they are morphologically identical or the slight differences discernible between some specimens can be shown to intergrade. It has not been possible as yet to rear this parasite through more than one generation, but it may be that more successful biological studies will show that the same forms will oviposit in all these diverse hosts. If such is the case, the selection of a host by this species is governed solely by the availability of that host. All the host species for *S. side* occur in about the same environment.

Doner¹⁷ has given a brief life history of this species, under the name *Spilochalcis torvina* (Cresson). He reared it as a rare primary pupal parasite of *Coleophora pruniella*.

Hosts.—*Laphygma frugiperda* Abbot and Smith (Lepidoptera, Noctuidae); *Paralechia pinifoliella* Chambers, *Recurvaria piceaella* Kearfott (Gelechiidae); *Ancylis comptana* Froehlich, *Ancylis divisana* Walker (Eucosmidae); *Choreutis silphiella* Busck (Glyphipterygidae); *Plutella maculipennis* Curtis (Plutellidae); *Argyresthia thuiella* Packard (Yponomeutidae); *Coleophora laricella* (Hübner), *Coleophora malivorella* Riley, *Coleophora fletcherella* Fernald, *Coleophora salmani* Heinrich, *Coleophora pruniella* Clemens (Coleophoridae); *Bucculatrix thurberiella* Busck (Lyonetidae).

Orchestes pallicornis Say, *Hypera rumicis* (Linnaeus), *Phytonomus nigrirostris* Fabricius (Coleoptera, Curculionidae).

Angitia plutellae Viereck, *Angitia hellulae* Viereck (Hymenoptera, Ichneumonidae); *Meteorus versicolor* (Wesmael), *Apanteles militaris* (Walsh) (Braconidae).

¹⁷ Ann. Ent. Soc. Amer., vol. 29, p. 234, 1936.

Distribution.—Arizona, British Columbia, California, Colorado, Connecticut, Delaware, District of Columbia, Florida, Georgia, Idaho, Illinois, Iowa, Kansas, Maine, Maryland, Massachusetts, Minnesota, Montana, New Hampshire, New Jersey, New Mexico, New York, Ohio, Oklahoma, Ontario, Oregon, Quebec, Saskatchewan, South Dakota, Tennessee, Texas, Utah, Virginia, Washington, Wisconsin.

SPILOCHALCIS ALBIFRONS (Walsh)

Chalcis albifrons WALSH, Trans. Illinois State Agr. Soc., vol. 4, p. 369, 1861.—CRESSON, Proc. Ent. Soc. Philadelphia, vol. 1, p. 229, 1862.—WALSH, Trans. Illinois State Agr. Soc., vol. 5, p. 483, 1865.—RILEY, 2d annual report on the noxious, beneficial and other insects of the State of Missouri, p. 52, 1870.—WALKER, Notes on Chalcididae, p. 46, 1871.—RILEY, 8th annual report on the noxious, beneficial and other insects of the State of Missouri, p. 54, 1876.—THOMAS, 10th report of the State entomologist of Illinois, p. 40, 1881.—PACKARD, Guide to the study of insects . . . , p. 203, 1889.

Smicra albifrons (Walsh) CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 35, 39, 1872; Synopsis of the families and genera of Hymenoptera of America north of Mexico, p. 233, 1887.

Spilochalcis albifrons (Walsh) HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 7, 1885; U. S. Dept. Agr. Bur. Ent. Techn. Ser. Bull. 5, p. 34, 1897.—SCHMIEDER-KNECHT, Genera Insectorum, fasc. 97, p. 38, 1909.—SMITH, Ann. Rep. New Jersey State Mus. for 1909, p. 649, 1910.—GIRAULT, Proc. U. S. Nat. Mus., vol. 58, p. 192, 1920.—DUNNMAN, Journ. Agr. Res., vol. 34, p. 154, 1927.—LEONARD, Cornell Univ. Agr. Exp. Stat. Mem. 101, p. 976, 1928.—WILSON, Florida Ent., vol. 16, p. 39, 1932; vol. 17, p. 3, 1933; Florida Agr. Exp. Stat. Techn. Bull. 271, p. 16, 1935.

Spilochalcis torvina ancylae GIRAULT, Proc. U. S. Nat. Mus., vol. 58, p. 192, 1920.

The male of this species, while almost identical with that of *Spilochalcis side* (Walker), is recognized most easily by the angular yellow mark located just dorsad of the clypeus. The female is considerably darker and averages larger than the female of *side*. In some cases it is impossible to distinguish the females of these two species.

Description.—Male: 2.5–3.5 mm. Identical with the male of *S. side*, redescribed on p. 337, except in the following particulars: Apex of scape reaching, but not exceeding, level of vertex; pedicel one and one-half to one and one-quarter times as long as segment 4, ring segment one-third as long as segment 4; diameter of posterior ocellus one-half as great as width of interocellar space. Prepectus often entirely concealed, when visible, extremely narrow and not quite touching tegula; outer ventral margin of metafemur with 11 to 16 minute teeth. Petiole shagreened, three to four times as long as wide, lateral carinae almost always well developed, a sparse row of long setae usually present along each dorsolateral angle of petiole; gaster usually equal in length to metafemur, occasionally slightly shorter; penis valve similar in form to that of *S. side* (fig. 14, *l*), but proportionately longer and slenderer.

Type locality.—Illinois.

Type.—Walsh's type of this species is lost, but a single male specimen in the U. S. National Museum is labeled "Type of *Chalcis albifrons* Walsh" and bears the catalog number 1530. As this specimen was collected 8 years after the description was published, it cannot be Walsh's type. Cresson redescribed this species in 1872, but the specimens he had then very likely have been lost subsequently. The two specimens now in the collection of the Academy of Natural Sciences of Philadelphia labeled "*Smicra albifrons*" do not agree with his redescription of the species. One is a female with the frons almost entirely black; the other is a specimen of *Spilochalcis melana*, new species, described on p. 316 above. The type in the National Museum may as well, therefore, be considered as the neotype for this species.

Hosts.—*Arogalea cristifasciella* Chambers (Lepidoptera, Gelechiidae); *Ancylis comptana* Froehlich, *Ancylis divisana* Walker, *Polychrosis viteana* Clemens (Eucosmidae); *Plutella maculipennis* Curtis (Plutellidae); *Coleophora fletcherella* Fernald, *Coleophora laricella* (Hübner), *Coleophora pruniella* Clemens, *Coleophora salmani* Heinrich (Coleophoridae).

Bathyplectes exigua (Gravenhorst) (Hymenoptera, Ichneumonidae); *Apanteles atalantae* (Packard), *Apanteles congregatus* (Say), *Apanteles griffini* Viereck, *Apanteles lacteicolor* Viereck, *Apanteles militaris* Walsh (Braconidae).

This species has been reared, undoubtedly from some ichneumonoid primary parasites of the following moths: *Plathypena scabra* (Fabricius) and *Thyridopteryx ephemeraeformis* Haworth.

Distribution.—British Columbia, California, Colorado, Delaware, District of Columbia, Florida, Idaho, Illinois, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Montana, New Hampshire, New Jersey, New York, Ohio, Ontario, Oregon, Pennsylvania, South Dakota, Texas, Virginia, Washington, West Virginia, Wisconsin, Wyoming.

SPILOCHALCIS LEPTIS, new species

FIGURES 9, n; 14, m

This species is closely related to *Spilochalcis side* (Walker) but differs in the male in having a shorter pedicel (fig. 9, n) and the lateral ocelli located very near to the inner margins of the compound eyes, not separated by a distance greater than the diameter of the ocellus, as in *side*; the male has the entire frons ventrad and laterad of the scrobe cavity yellow or whitish; the female is difficult to separate from the *side* female, but the large lateral ocelli located close to the compound eyes, and the scrobe cavity extending to the anterior

ocellus, not ended ventrad of it, can usually be relied upon to distinguish the female of this species.

Description.—Male: 2.5–3.5 mm. Antennae inserted dorsad of ventral margins of compound eyes, apex of scape not quite reaching level of posterior margin of anterior ocellus, pedicel equal to or slightly longer than segment 4, ring segment one-third to one-fourth length of pedicel, segments 4 to 8 equal, 9 and 10 slightly shorter, last three combined equal in length to 7 and 8; scrobe cavity shallow; frontal tentorial pits usually visible just laterad of antennal bases; width of malar space two-fifths height of compound eyes; combined widths of compound eyes slightly greater than interocular space at level of apex of interantennal projection; posterior ocelli separated from compound eyes by a distance less than diameter of ocellus; dorsal width of head slightly less than maximum dorsal width of thorax.

Prepectus minute, reaching tegula; apex of mesoscutellum with a minute, mesally depressed lamina; metepisternum with deep, scattered punctures, dorsal ones slightly smaller than ventral ones; metacoxae minutely shagreened, outer surface also shallowly and irregularly pitted; metafemur lightly shagreened, outer surface rather densely covered with short pubescence, ventral margin with 14 to 17 teeth, basal one only slightly larger than others; obscure inner tooth present.

Propodeum irregularly carinate, two shagreened or minutely reticulated basolateral areas present, a minute tooth present at each posterolateral angle, spiracles slanting slightly laterad; petiole two and one-half to three times as long as wide, basal lamina minute, lateral carinae present, but rather vague; gaster equal to or slightly longer than metafemur; eighth tergite very lightly shagreened, almost glabrous, sparsely setose, spiracles round; cerci oval, located near posterior margin of ninth tergite; penis valve (fig. 14, *m*).

Type locality.—California.

Type.—Holotype, male, Lassen National Forest, Calif., July 25, 1934, R. L. Furniss; allotype, female, same data as for holotype; paratypes, Lassen National Forest, Calif., July 25, 1934, ex *Zelleria haimbachi*, R. L. Furniss, 1 female, Colorado, 5 females, 3 males, Yerington, Nev., July 27, 1909, 3 males, Hollister, Idaho, June 10–24, 1930, D. E. Fox, 2 males, May 16–June 26, 1931, D. E. Fox, 3 females, 1 male, Tuttle, Idaho, July 14, 1931, D. E. Fox, 1 male, Kimama, Idaho, June 22, 1931, D. E. Fox, 1 male. Holotype, allotype, and 10 paratypes deposited in the U. S. National Museum; two paratypes, Cornell University; six paratypes, Colorado Agricultural College; two paratypes, Illinois State Natural History Survey.

Hosts.—*Zelleria haimbachi* Busck (Lepidoptera, Yponomeutidae); *Ancylis comptana* Froehlich, *Tmetocera ocellana* Schiffermüller (Eucosmidae); *Cacoecia argyrospila* (Walker) (Tortricidae).

Distribution.—In addition to the localities in the type series, material has been secured from Arizona, Iowa, Kansas, Missouri, Montana, Utah, Texas.

SPILOCHALCIS DELUMBIS (Cresson)

FIGURES 9, *o*; 14, *n*

Smicra delumbis CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 36, 40, 1872.—ASHMEAD, *ibid.*, vol. 12, p. x, 1885.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 34, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 375, 1898.—SCHMIEDEKNECHT, Genera Insectorum, fasc. 97, p. 34, 1909.

Spilochalcis delumbis (Cresson) VIERECK, Trans. Amer. Ent. Soc., vol. 32, p. 184, 1906.—CHAMBERLIN, Proc. Ent. Soc. Washington, vol. 35, p. 101, 1933.

Spilochalcis delumbis is separable from *S. side* only by critical characters. Each of these species is, furthermore, quite variable, but as the variation from one to the other is not quite continuous, they had best be retained as different species. As I have seen over a thousand specimens of these two species from a great many localities, the discontinuity between them probably will not disappear when more material is secured. The males are usually readily separable, but the females are to be distinguished only with difficulty.

The male of this species always has the antennae inserted on a level with the ventral margins of the compound eyes; the pedicel is small and cup-shaped and considerably narrower than the flagellum. The vertex is subacute rather than broadly rounded. Only an occasional male specimen has an angular color band dorsad of the clypeus; the interocular space is wide and the compound eyes are narrow. In the female, the vertex is subacute, the interocular space is wide and the eyes narrow, and the mesal projection of the eighth sternite is acute; this last character is often difficult to see, as the tergites of the anterior abdominal segments usually project ventrad so as to conceal the eighth sternite.

Description.—Male: 4–5 mm. Antennae inserted on a level with ventral margins of compound eyes, scape (fig. 9, *o*) with apex reaching level of dorsal margin of anterior ocellus, pedicel narrower than flagellum, three-quarters length of segment 4, ring segment one-quarter length of 4, 5 slightly longer than 4, segments 5 to 12 variable, usually equal in length, 12 often appearing subdivided, 13 minute; scrobe cavity shallow, margin usually completely acarinate, sometimes with obscure lateral carinae, glabrous areas lacking; frons irregularly and very minutely reticulated and shagreened, setae short, rather dense over most of surface; width of malar space one-half height of compound eye; combined widths of compound eyes one-fifth less than interocular space; left mandible with two teeth, ventral

one larger, right mandible with three teeth; diameter of posterior ocellus slightly less than one-half interocellar space.

Dorsum of thorax shallowly and irregularly punctured, setae inconspicuous except at ventral margin of mesopraescutum, on lobes of mesoscutum, axillae, and lateral margins of mesoscutellum; antero-lateral and sublateral angles of pronotum produced and rounded, anterior dorsal margin acarinate; prepectus blunt at apex, reaching tegula; mesoscutellum with a very narrow, mesally depressed apical lamina; metacoxae strongly shagreened on outer dorsal surface, slightly less strongly reticulated and setose elsewhere; metafemora stout, minutely reticulated on outer surface, ventral margin with 17 to 26 minute teeth, the basal one only slightly larger than following ones; inner tooth blunt.

Propodeum with a very few lateral setae, surface completely covered by small carinae, basolateral areas usually with somewhat irregular, oblique carinae, lateral teeth wanting, spiracular openings slanting laterad; petiole shagreened, stout, less than twice as long as wide, basal lamina narrow on dorsal side, distinct lateral carinae present; gaster usually equal in length to metafemora, abdominal segments 3 to 6 almost glabrous on dorsal side, segment 7 faintly reticulated; eighth tergite shagreened, setae short and sparse, spiracular openings oval; ninth tergite provided with long setae, cerci oval, located nearer posterior than anterior margin; penis valve (fig. 14, *n*).

Type locality.—Massachusetts.

Types.—Holotype, male, 1781.1; allotype, female, 1781.2: Academy of Natural Sciences of Philadelphia.

Hosts.—*Lema trilineata* (Olivier), *Lema nigrovittata* (Guérin), *Chlamys plicata* (Fabricius) (Coleoptera, Chrysomelidae).

Distribution.—Arizona, Arkansas, California, Colorado, District of Columbia, Florida, Illinois, Iowa, Kansas, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New York, Ohio, Texas, Virginia.

Genus CERATOSMICRA Ashmead

Ceratasmicra ASHMEAD, Mem. Carnegie Mus., vol. 1, p. 251, 1904.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 30, 1909.—GAHAN and FAGAN, U. S. Nat. Mus. Bull. 124, p. 29, 1923. (Genotype, *Ceratasmicra lissa*, new name for *Ceratasmicra petiolata* Ashmead, not Cresson.)

Sayiella ASHMEAD (not Dall), Mem. Carnegie Mus. vol. 1, p. 251, 1904.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 30, 1909.

Eusayia ASHMEAD (new name for *Sayiella*), Proc. Ent. Soc. Washington, vol. 6, p. 126, 1904.—GAHAN and FAGAN, U. S. Nat. Mus. Bull. 124, p. 63, 1923.

Melanosmicra ASHMEAD, Mem. Carnegie Mus., vol. 1, p. 251, 1904.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 31, 1909.—GAHAN and FAGAN, U. S. Nat. Mus. Bull. 124, p. 84, 1923.

Mischosmicra ASHMEAD, Mem. Carnegie Mus., vol. 1, p. 251, 1904.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 31, 1909.—GAHAN and FAGAN, U. S. Nat. Mus. Bull. 124, p. 90, 1923.

Description.—Antennal scape long, either attaining level of posterior ocelli or markedly exceeding it; left mandible with either two or three teeth, right mandible always with three teeth; body shallowly and irregularly pitted, dorsum of thorax often partly glabrous; pubescence conspicuously long, white; metafemora relatively slender (fig. 12, *l-o*), outer ventral margin with numerous, minute teeth, basal one always slightly longer than following ones; petiole long, slender, varying from 8 times as long as wide to 15 times as long as wide, length of petiole always three-fourths or more length of metacoxa, often as long as metacoxa; petiole occasionally enlarged just caudad of the middle (fig. 13, *h*); basal lamina of petiole usually wide, always directed caudad on ventral side.

The species of *Ceratasmicra* are, where known, hyperparasites; they usually emerge from the cocoons of *Apanteles* or *Meteorus*.

KEY TO SPECIES OF CERATOSMICRA

1. A strong tooth projecting from venter of propodeum between bases of metacoxae; petiole 14 or more times as long as wide at its widest point..... *debilis* (p. 344)
 Propodeum without a ventral tooth; petiole shorter..... 2
2. Petiole enlarged between base and apex (fig. 13, *h*); length of petiole 8 to 9 times its maximum width..... *meteori* (p. 346)
 Petiole not enlarged between base and apex; more than 11 times as long as wide..... 3
3. Flange at base of petiole broader on dorsal than on ventral side; propodeum with lateral teeth..... *paya* (p. 348)
 Flange at base of petiole wider on ventral than on dorsal side; propodeum entirely without lateral teeth..... *immaculata* (p. 350)

CERATOSMICRA DEBILIS (Say)

FIGURES 9, *p*; 12, *m*

Chalcis debilis SAY, Boston Journ. Nat. Hist., vol. 1, p. 271, 1836.—CRESSON, Proc. Ent. Soc. Philadelphia, vol. 1, p. 228, 1862.—HOWARD, U. S. Dept. Agr. Bur. Ent. Bull. 5, p. 36, 1885.

Smicra debilis (Say) WALKER, Notes on Chalcididae, p. 51, 1871.—CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 37, 47, 1872; Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 375, 1898.

(?) *Spilochalcis debilis* (Say) SMITH, Ann. Rept. New Jersey State Mus. for 1909, p. 649, 1910.

Smicra longipetiolata ASHMEAD, Trans. Amer. Ent. Soc., vol. 12, p. x, 1885.—CRESSON, Synopsis of the families and genera of the Hymenoptera of America north of Mexico, p. 233, 1887.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 378, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 35, 1909.

Mischosmicra kahlil ASHMEAD, Mem. Carnegie Mus., vol. 1, p. 251, 1904.—SCHMIEDEKNECHT, Genera Insectorum, fasc. 97, p. 43, 1909.—GAHAN and FAGAN, U. S. Nat. Mus. Bull. 124, p. 90, 1923.

This species is most easily recognized by the large deep pits on the dorsum of the thorax, the ventral tooth of the propodeum projecting between the bases of the metacoxae, and the very long slender petiole, with the basal flange wanting on the dorsal side, but present on the ventral side.

Description.—Yellowish red to dark brown, with variable dark-brown or black markings, occasional specimens almost entirely without darker markings; vertex and occiput of head, large mesal area of mesopraescutum, all but lateral margins of lobes of mesoscutum, anterior halves of axillae, mesal area of mesoscutellum, apices of metacoxae, outer surface of metafemur except basal, apical, and dorsal spots (fig. 12, *m*), apex of petiole, and transverse dorsal stripes on gaster, usually dark brown or black.

Female: 4–4.5 mm. Apex of antennal scape just attaining level of posterior ocelli; ring segment slightly less than one-fourth length of segment 4, segments 4 to 13 almost equal in length, 12 and 13 often appearing subdivided; scrobe cavity smooth, margined by distinct carinae, the carinae usually double on ventral half; frons minutely shagreened, smooth dorsad of clypeus and between anterior tentorial pits; combined widths of compound eyes equal to interocular space at level of antennal bases; both mandibles with three approximately equal teeth; frontogenal suture straight; diameter of posterior ocellus one-fourth width of interocellar space.

Anterolateral angles of pronotum sharply produced, anterior dorsal margin acarinate; maximum length of mesopraescutum as great as width at widest point; dorsum of thorax coarsely and irregularly punctate, provided with scattering short, white, appressed pubescence; an erect tuft of setae present on each axilla; metacoxae extremely long, slender at apex, uniformly and minutely shagreened; metafemur elongate, outer surface slightly flattened, densely covered with short, white pubescence; ventral margin with 13 to 16 teeth; small sharp inner tooth present; metatibia with apex long, slender, lanceolate.

Propodeum prominently carinate, a small, vertical lamina present at apex on either side of point of insertion of petiole, a sharp, lateral tooth present at each posterolateral angle of propodeum, and a ventral projection extending between bases of metacoxae; petiole as long as metacoxa, surface usually shagreened, the petiole slightly enlarged at apex; basal lamina of petiole present only on ventral and lateral sides; gaster slightly larger than metafemur, acuminate; cerci round, located midway between posterior and anterior margins of epipygium, and placed in a slight depression; ovipositor sheaths provided with minute apical setae.

Male: 4-4.5 mm. Antennal scape (fig. 9, *p*) exceeding level of posterior ocelli; metafemur with inner tooth blunt; petiole slightly longer than metacoxa, and only slightly enlarged at apex; gaster equal to or shorter than metafemur.

Type locality.—Indiana.

Type.—Neotype, female, Delaware, in Academy of Natural Sciences of Philadelphia, E. T. Cresson determination.

The identity of this species has become somewhat confused. Say's type has long since been lost, but Cresson redescribed it in 1872, and as his material is still available I have considered it as fixing the identity of this species. The original description mentions only one structural character, the presence of minute teeth on the propodeum, and this character is present in specimens determined as this species by Cresson. These propodeal teeth are wanting in the specimens determined as this species by Howard and others. Most of the American references to this species are now applied to *Ceratosmicra meteori*, described below.

Types for synonyms: *longipetiola* Ashmead, 41182, U. S. National Museum; *kahlui* Ashmead, 8073, U. S. National Museum.

The types of *S. longipetiola* Ashmead and *M. kahlui* Ashmead differ neither in color nor in structure from the specimens determined as *S. debilis* (Say) by E. T. Cresson.

Host.—Unknown.

Distribution.—Delaware, Florida, Illinois, Iowa, Kansas, Louisiana, Michigan, Minnesota, New York, Pennsylvania, Rhode Island, Texas.

CERATOSMICRA METEORI, new name

FIGURES 9, *q*; 10, *f*; 12, *o*; 13, *h*

Smicra meteori HOWARD (MS. name), Journ. Linn. Soc. London, Zool., vol. 26, p. 131, 1897.

Spilochalcis debilis HOWARD (not Say), U. S. Dept. Agr. Div. Ent. Techn. Ser. Bull. 5, p. 33, 1897.—VIERECK, Connecticut Geol. and Nat. Hist. Surv. Bull. 22, p. 527, 1916.—WASHBURN, 17th Report of the entomologist of Minnesota, p. 193, 1918.—(?) RUHL, Soc. Ent., Stuttgart, vol. 36, p. 11, 1921.

Saytella debilis ASHMEAD, Mem. Carnegie Mus., vol. 1, p. 251, 1904.—SCHMIEDER-KNECHT, Genera insectorum, fasc. 97, p. 42, 1909.

Eusayia debilis ASHMEAD, Proc. Ent. Soc. Washington, vol. 6, p. 126, 1904.—BRITTON, Connecticut Geol. and Nat. Hist. Surv. Bull. 31, p. 326, 1920.—GAHAN and FAGAN, U. S. Nat. Mus. Bull. 124, p. 63, 1923.

This species resembles *C. immaculata* (Cresson) in lacking lateral propodeal projections, having fairly slender metafemora (fig. 12, *o*), and having the petiole approximately 10 times as long as wide at the widest point; it differs in having the petiole expanded in the middle (fig. 13, *h*), and the male antennal scape broad from the base to the apex (fig. 9, *q*), rather than broad only at the apex (fig. 9, *s*).

Description.—Pale yellow, with tan, brown, or black markings; markings variable, vertex and occiput of head usually, three dorsal marks on pronotum, broad band extending from apex of mesoscutellum to anterior margin of mesopraescutum (fig. 10, *f*), isolated spot on each lobe of mesoscutum, anterior and posterior margins of axillae, faint markings on outer surface of metafemur (fig. 12, *o*), and usually transverse dorsal bands on gaster, tan, brown, or black.

Female: 4.5–5 mm. Apex of antennal scape just attaining level of posterior ocelli; ring segment one-fourth length of segment 4, segments 4 to 10 equal, last three slightly shorter; scrobe cavity shallow, edge carinate only at ventral margin; interantennal projection with a small carina, this carina usually extending up into scrobe cavity nearly to anterior ocellus, sometimes somewhat shorter; frons laterad of scrobe cavity uniformly covered with large shallow punctures, area ventrad of antennal bases minutely shagreened; width of malar space one-quarter height of compound eye; combined widths of compound eyes slightly greater than interocular space at level of antennal bases; left mandible with two acute teeth, right with three, dorsal one larger and blunt, two ventral ones small, acute, their apices converging slightly; frontogenal suture curved; diameter of posterior ocellus one-half width of interocellar space.

Anterolateral angles of pronotum minutely carinate, anterior dorsal margin acarinate; maximum length of mesopraescutum slightly less than maximum width; parapsidal furrows partly obscured; axillae each with a single row of setae near posterior margin; apex of mesoscutellum provided with a minute lamina; metepisternum conspicuously punctured, setae inconspicuous; surface of metacoxa uniformly shagreened, without setae on outer dorsal side; metafemur (fig. 12, *o*) rather narrow, not flattened on outer side, outer surface sparsely provided with setae, ventral margin with 16 to 20 minute teeth; small inner tooth present; apex of metatibia acute.

Propodeum mostly smooth, minute mesal and apical carinae present, lateral projections wanting; petiole three-fourths length of metacoxa, surface minutely shagreened, a sparse double row of long setae present on either side, basal lamina narrow, not interrupted on dorsal side, petiole markedly expanded in middle (fig. 13, *h*); gaster acuminate, usually one-fourth longer than metafemur; abdominal tergites 4 to 7 each with two or three transverse rows of setae; cerci oval, located midway between base and apex of epipygium; apex of ovipositor sheath minutely roughened.

Male: 3.5–4 mm. Antennal scape broad from base to apex (fig. 9, *q*), apex of scape slightly exceeding level of posterior ocelli, metafemur with 16 to 18 outer ventral teeth, inner tooth sharp; petiole

four-fifths length of metacoxa; gaster slightly shorter than meta-femur; ninth sternite slightly flattened near apex.

Type locality.—District of Columbia.

Types.—Lectotype, female, Washington, D. C., 78⁰¹, October 1886; lectoallotype, Washington, D. C., 78⁰¹, January 25, 1887, both reared from *Meteorus hyphantriae* parasitic on *Hemerocampa leucostigma*: in the collection of the U. S. National Museum.

In describing his West Indian species *Smicra cressoni*, Howard¹⁸ stated that "it resembles most closely *S. meteori* of the writer's manuscript, reared from *Meteorus hyphantriae* Riley in the District of Columbia." This is practically a description, but does not, in my opinion, validate the name under the International Code. Opinion No. 52 rendered by the International Commission holds that the designation of a type locality does not validate a name, and the host designated in the above quotation is probably attacked by other members of this genus. In the same year in which this manuscript name was published, Howard treated this species under the name *Spilochalcis debilis* (Say), discussed its biology, and figured the adult. As has been remarked on page 346 above, the identity of Say's species had been fixed by Cresson in 1872 and was a different species from this one. The figure and biological notes published by Howard for his identification of *S. debilis* constitute a valid description for this species; therefore, I have used his manuscript name as a new name for *Spilochalcis debilis* Howard, not Say. The most of Howard's material is still in the U. S. National Museum.

Hosts.—*Casinaria orgyiae* (Howard) (Hymenoptera, Ichneumonidae); *Meteorus hyphantriae* Riley, *Meteorus* sp., *Apanteles delicatus* Howard, *Apanteles* sp. (Braconidae).

Distribution.—Connecticut, District of Columbia, Illinois, Louisiana, Maryland, New York, North Carolina, Pennsylvania, Tennessee, Texas, Virginia, West Virginia.

CERATOSMICRA PAYA, new species

FIGURES 9, r; 10, d; 12, l

This small black species with yellow and red spots is much like *Spilochalcis side* (Walker) in habitus, but its long slender petiole refers it to this genus. It differs from all other species in this genus by the extremely wide basal lamina of the petiole, and the metacoxa strongly punctured on the ventral side with the outer dorsal surface strongly shagreened; in *C. debilis* (Say), which this species most closely resembles, the metacoxa is slender at the apex and lacks strong punctures on the ventral side.

¹⁸ Journ. Linn. Soc. London, Zool., vol. 26, p. 181, 1897.

Description.—Black with red, yellow, or white spots; usual color pattern of dorsum of thorax (fig. 10, *d*); color pattern of metafemur (fig. 12, *l*); petiole brown, sometimes darker in middle or at apex; gaster with transverse dorsal black bands.

Female: 4.5 mm. Apex of antennal scape just attaining level of posterior ocelli, ring segment one-fourth length of segment 4; 5 slightly shorter than 4; segments 5 to 10 subequal, last three shorter, ultimate segment blunt at apex; scrobe cavity moderately deep, margin carinate ventrad and on ventral one-third of lateral margins; frons uniformly and densely punctured and covered with long, dense pubescence except for narrow glabrous area dorsad of clypeus; interantennal projection provided with an apical carina, this carina continued dorsad up scrobe cavity nearly to anterior ocellus; width of malar space one-third height of compound eye; combined widths of compound eyes equal to interocular space at level of antennal bases; right mandible with one sharp dorsal tooth and two slightly smaller, acute ventral ones; left mandible with two sharp teeth, dorsal one slightly larger; frontogenal suture straight; diameter of posterior ocellus one-third width of interocellar space.

Dorsum of thorax deeply and thickly punctured, areas between punctures minutely reticulated; anterolateral angles of pronotum strongly carinate; anterior dorsal margin without a carina; mesopraescutum as long as wide at widest point, parapsidal furrows distinct; each axilla with a dense, transverse row of setae; wings covered by minute brown setae; metepisternum deeply pitted, densely covered by long pubescence; metacoxae shagreened on dorsal, inner, and ventral surfaces, but elsewhere covered by large shallow pits, uniformly pubescent except on outer dorsal surface, large rounded projection present at apex on inner side; metafemur (fig. 12, *l*) elongate, outer surface uniformly and densely covered by short pubescence; ventral margin with 18 to 20 teeth; large, blunt inner tooth present, apex of metatibia sharp.

Propodeum conspicuously carinate except on basolateral areas, two strongly projecting teeth present at apex on either side of point of insertion of petiole; petiole five-sixths the length of metacoxa, basal lamina of petiole extremely wide, petiole slightly enlarged near apex, surface entirely glabrous and with only three or four setae on lateral margins; gaster globose, slightly less than length of metafemur; abdominal tergites 3 to 5 without setae, segments 6 and 7 with a few scattered lateral setae; eighth tergite uniformly covered by long white setae; cercus oval, located near anterior margin of epipygium; apex of ovipositor sheath minutely roughened.

Male: 4 mm. Antennal scape (fig. 9, *r*) enlarged near apex; metafemur with 16 or 17 outer ventral teeth; inner tooth distinct, blunt;

petiole equal in length to metacoxa; gaster equal in length to meta-femur.

Type locality.—Texas.

Types.—Holotype, female, Dallas, Tex., October 21, 1906, F. C. Bishopp; allotype, male, Los Angeles County, Calif.; paratypes, Peoria, Ill., October 10, 1936, H. E. McClure, 1 male, Manhattan, Kans., October 6, 1934, C. W. Sabrosky, 1 female, Riley County, Kans., September 9, E. E. Faville, 1 female. Holotype, allotype, and one paratype deposited in the U. S. National Museum, one paratype in the Illinois State Natural History Survey collection, and one paratype in the University of Kansas collection.

Host.—Unknown.

CERATOSMICRA IMMACULATA (Cresson)

FIGURES 9, s; 12, n

Smiera immaculata CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 97, 1865;

The Cresson types of Hymenoptera, p. 75, 1916.

Smicra immaculata (Cresson) WALKER, Notes on Chalcididae, p. 51, 1871.—

CRESSON, Trans. Amer. Ent. Soc., vol. 4, pp. 38, 55, 1872.—DALIA TORRE,

Catalogus hymenopterorum, vol. 5, p. 377, 1898.—SCHMIEDEKNECHT, Genera insectorum, fasc. 97, p. 35, 1909.

This minute, yellow species is most easily recognized by its long, slender, and glabrous petiole, the propodeum being entirely without lateral teeth, the glabrous outer dorsal surface of the metacoxa, and the metafemur being entirely without an inner tooth.

Description.—Yellow, occasionally with vague, indistinct darker stains on dorsum of thorax and abdomen; outer surface of meta-femur with three small, vague spots (fig. 12, n); apical tarsal segments always brown.

Female: 3-3.5 mm. Apex of antennal scape exceeding level of posterior ocelli; ring segment one-third length of segment 4, all flagellar segments approximately equal, stout, covered by white pubescence; scrobe cavity shallow, margined only at ventral one-eighth; frons laterad of scrobe cavity strongly punctate, minutely shagreened ventrad of antennal bases; malar space one-fourth height of compound eyes; combined widths of compound eyes slightly greater than width of interocular space at level of antennal bases; left mandible with two acute teeth, right mandible with three; frontogenal suture faint or obscured entirely; diameter of posterior ocellus one-half width of interocellar space.

Pronotum narrow, without an anterior dorsal carina, slight carina at anterolateral angles; mesopraescutum slightly shorter than width at widest point; dorsum of thorax shallowly punctate, almost glabrous in some specimens, pubescence long and white; posterior margins of

axillae with a few long setae; metacoxae long, outer dorsal surface glabrous, elsewhere minutely shagreened; metafemora (fig. 12, *n*), elongate, not flattened on outer surface, densely covered with short, white pubescence, ventral margin with 15 to 17 teeth, inner tooth wanting; metatibia with long, acute apical spine.

Propodeum almost smooth, vague mesal and apical carinae present, no lateral projections present, spiracular openings vertical; petiole four-fifths the length of metacoxa, glabrous, slightly larger at apex than at base, basal lamina narrower on dorsal than ventral side; gaster slightly shorter than metafemur; cerci oval, large, located slightly nearer posterior than anterior margin of epipygium.

Male: 3 mm. Antennal scape (fig. 9, *s*) broad only at apex; metafemur without an inner tooth, outer ventral margin with 12 or 13 teeth; petiole five-sixths the length of metacoxa; gaster equal in length to metafemur.

Type locality.—Cuba.

Types.—Holotype, female, 1795.1; allotype, male, 1795.2: Academy of Natural Sciences of Philadelphia.

Host.—*Meteorus* sp. (Hymenoptera, Braconidae).

Distribution.—TEXAS: Brownsville, ex *Meteorus* sp., E. G. Smyth, 3 males, June 23, 1914, ex *Meteorus* sp., R. A. Vickery, 1 female, December 17, 1910, 2 females; Cameron County, August 3, 1928, R. H. Beamer, 1 female.

EXCLUDED SPECIES

Smicra gigantea ASHMEAD, Can. Ent., vol. 13, p. 90, 1881.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 372, 1898.

This species is a synonym of *Phasgonophora sulcata* Westwood; the type is in the U. S. National Museum.

Chalcis myrifer (SULZER), Abgek. Gesch. Ins., vol. 1, p. 191, 1776.—WALKER, Notes on Chalcidae, p. 52, 1871.—CRESSON, Trans. Amer. Ent. Soc., vol. 4, p. 55, 1872.—DALLA TORRE, Catalogus hymenopterorum, vol. 5, p. 380, 1898.

Walker, Cresson, and Dalla Torre list this European species as occurring in North America, but material of this species from Europe proves to be different from all our species.

UNPLACED SPECIES

Smicra bimaculata STRECKER, Appendix SS to Report of the Chief of Army Engineers for 1878, p. 1848, 1879.—BRADLEY, Ent. News, vol. 14, p. 26, 1903.

I have not succeeded in locating the type of this species; it is not in the Strecker collection at the Field Museum, in Chicago, Ill. This species may either be a member of the genus *Chalcis* or belong to the *xanthostigma* group of *Spilochalcis*.

HOST CATALOG

The species of the genus *Chalcis* are larval parasites; all the other species in this tribe that have been reared are pupal parasites.

LEPIDOPTERA

PIERIDAE

| Host | Parasite |
|--|---|
| <i>Uatopsilia eubule</i> (Linnaeus)----- | <i>Spilochalcis eubule</i> (Cresson) |
| | <i>Spilochalcis transitiva</i> (Walker) |

NYMPHALIDAE

| | |
|--|---|
| <i>Chlosyne lacinia crocale</i> Edwards----- | <i>Spilochalcis phoenicea</i> , new species |
|--|---|

LYCAENIDAE

| | |
|---|--------------------------------|
| <i>Strymon melinus</i> (Hübner)----- | <i>Metadontia amoena</i> (Say) |
| <i>Strymon cecrops</i> (Fabricius)----- | <i>Metadontia amoena</i> (Say) |
| <i>Thecla</i> sp----- | <i>Metadontia amoena</i> (Say) |

SATURNIIDAE

| | |
|--|------------------------------------|
| <i>Philosamia cynthia</i> Drury----- | <i>Spilochalcis mariae</i> (Riley) |
| <i>Samia cecropia</i> (Linnaeus)----- | <i>Spilochalcis mariae</i> (Riley) |
| <i>Callosamia promethea</i> Drury----- | <i>Spilochalcis mariae</i> (Riley) |
| <i>Telea polyphemus</i> Cramer----- | <i>Spilochalcis mariae</i> (Riley) |
| <i>Rothschildia</i> sp----- | <i>Spilochalcis mariae</i> (Riley) |

NOCTUIDAE

| | |
|---|--|
| <i>Laphygma frugiperda</i> Abbot and Smith----- | <i>Spilochalcis side</i> (Walker) |
| | <i>Spilochalcis femorata</i> (Fabricius) |
| | <i>Spilochalcis igneoides</i> (Kirby) |
| <i>Plathypena scabra</i> (Fabricius)----- | <i>Spilochalcis albifrons</i> (Walsh) [secondary?] |
| (?) <i>Prodenia eridania</i> Cramer----- | <i>Spilochalcis sanguineiventris</i> (Cresson) |
| <i>Heliothis obsoleta</i> (Fabricius)----- | <i>Spilochalcis femorata</i> (Fabricius) |
| | <i>Spilochalcis igneoides</i> (Kirby) |

PSYCHIDAE

| | |
|---|--|
| <i>Thyridopteryx ephemeraeformis</i> Hb- worth ----- | <i>Spilochalcis mariae</i> (Riley) |
| | <i>Spilochalcis albifrons</i> (Walsh) [secondary?] |

LIMACODIDAE

| | |
|---|---|
| <i>Parasa indetermina</i> Boisduval----- | <i>Spilochalcis nigricornis</i> (Fabricius) |
| <i>Adoneta spinuloides</i> Herrich-Schaeffer----- | <i>Spilochalcis nigricornis</i> (Fabricius) |
| <i>Prolimacodes badia</i> (Hübner)----- | <i>Spilochalcis nortoni</i> (Cresson) |
| <i>Phobetreron pitheciun</i> Abbot and Smith----- | <i>Spilochalcis nortoni</i> (Cresson) |
| <i>Limacodes</i> sp----- | <i>Spilochalcis nigricornis</i> (Fabricius) |

PYRALIDAE

| | |
|---|--|
| (?) <i>Mimorista flavidissimalis</i> Grote----- | <i>Spilochalcis exornata</i> (Cresson) |
| <i>Homoeosoma electellum</i> Hulst----- | <i>Spilochalcis flavopicta</i> (Cresson) |

| | |
|---|--|
| <i>Acrobasis</i> sp.----- | <i>Spilochalcis flavopicta</i> (Cresson) |
| <i>Mineola indigenella</i> Zeller.----- | <i>Spilochalcis igneoides</i> (Kirby) |

GELECHIIDAE

| | |
|---|--|
| <i>Gelechia nundinella</i> Zeller.----- | <i>Spilochalcis dema</i> , new species |
| <i>Paralechia pinifoliella</i> Chambers----- | <i>Spilochalcis side</i> (Walker) |
| <i>Arogalea cristifasciella</i> Chambers----- | <i>Spilochalcis albifrons</i> (Walsh) |
| <i>Recurvaria piceaella</i> Kearfott----- | <i>Spilochalcis side</i> (Walker) |
| <i>Gnorimoschema</i> sp.----- | <i>Spilochalcis tanais</i> , new species |

EUCOSMIDAE

| | |
|---|--|
| <i>Ancylis comptana</i> Froehlich----- | <i>Spilochalcis flavopicta</i> (Cresson) |
| | <i>Spilochalcis albifrons</i> (Walsh) |
| | <i>Spilochalcis side</i> (Walker) |
| | <i>Spilochalcis leptis</i> , new species |
| <i>Ancylis divisana</i> Walker----- | <i>Spilochalcis side</i> (Walker) |
| | <i>Spilochalcis albifrons</i> (Walsh) |
| <i>Evetria frustrana</i> Comstock----- | <i>Spilochalcis flavopicta</i> (Cresson) |
| <i>Polychrosts viteana</i> Clemens----- | <i>Spilochalcis albifrons</i> (Walsh) |
| <i>Tmetocera ocellana</i> Schiffermuller----- | <i>Spilochalcis leptis</i> , new species |

TORTRICIDAE

| | |
|---|---------------------------------------|
| <i>Cacoecia argyrospila</i> (Walker)----- | <i>Spilochalcis albifrons</i> (Walsh) |
|---|---------------------------------------|

PHALONIIDAE

| | |
|--------------------------|--|
| <i>Phalonia</i> sp.----- | <i>Spilochalcis flavopicta</i> (Cresson) |
|--------------------------|--|

GLYPHIPTERYGIDAE

| | |
|--|---------------------------------------|
| <i>Choreutis silphiella</i> Busck----- | <i>Spilochalcis albifrons</i> (Walsh) |
|--|---------------------------------------|

PLUTELLIDAE

| | |
|--|---------------------------------------|
| <i>Plutella maculipennis</i> Curtis----- | <i>Spilochalcis side</i> (Walker) |
| | <i>Spilochalcis albifrons</i> (Walsh) |

YFONOMEUTIDAE

| | |
|--|--|
| <i>Zelleria haimbachi</i> Busck----- | <i>Spilochalcis leptis</i> , new species |
| <i>Argyresthia thuiella</i> Packard----- | <i>Spilochalcis side</i> (Walker) |

COLEOPHORIDAE

| | |
|---|---------------------------------------|
| <i>Coleophora laricella</i> (Hübner)----- | <i>Spilochalcis side</i> (Walker) |
| | <i>Spilochalcis albifrons</i> (Walsh) |
| <i>Coleophora malkvorella</i> Riley----- | <i>Spilochalcis side</i> (Walker) |
| | <i>Spilochalcis albifrons</i> (Walsh) |
| <i>Coleophora fletcherella</i> Fernald----- | <i>Spilochalcis side</i> (Walker) |
| | <i>Spilochalcis albifrons</i> (Walsh) |
| <i>Coleophora salmani</i> Heinrich----- | <i>Spilochalcis side</i> (Walker) |
| | <i>Spilochalcis albifrons</i> (Walsh) |
| <i>Coleophora pruniella</i> Clemens----- | <i>Spilochalcis side</i> (Walker) |
| | <i>Spilochalcis albifrons</i> (Walsh) |

LYONETIDAE

| | |
|--|-----------------------------------|
| <i>Bucculatrix thurbertella</i> Busck----- | <i>Spilochalcis side</i> (Walker) |
|--|-----------------------------------|

COLEOPTERA

CHRYSOMELIDAE

| | |
|---|--|
| <i>Lema trilineata</i> (Olivier)----- | <i>Spilochalcis delumbis</i> (Cresson) |
| <i>Lema nigrovittata</i> (Guérin)----- | <i>Spilochalcis delumbis</i> (Cresson) |
| <i>Chlamys plicata</i> (Fabricius)----- | <i>Spilochalcis delumbis</i> (Cresson) |
| <i>Æma conspersa</i> (Mannerheim)----- | <i>Spilochalcis sanguineiventris</i> (Cresson) |
| <i>Chalepus dorsalis</i> Thunberg----- | <i>Spilochalcis odontotac</i> Howard |

CURCULIONIDAE

| | |
|--|--|
| <i>Orchestes pallicornis</i> Say----- | <i>Spilochalcis side</i> (Walker) |
| <i>Phytonomus nigritrostris</i> Fabricius----- | <i>Spilochalcis side</i> (Walker) |
| <i>Hypera rumicis</i> (Linnaeus)----- | <i>Spilochalcis side</i> (Walker) |
| <i>Anthonomus grandis</i> Boheman----- | <i>Spilochalcis flavopicta</i> (Cresson) |

HYMENOPTERA

ICHNEUMONIDAE

| | |
|---|--|
| <i>Bathyplectes exigua</i> (Gravenhorst)----- | <i>Spilochalcis albifrons</i> (Walsh) |
| <i>Angitta plutellae</i> Viereck----- | <i>Spilochalcis side</i> (Walker) |
| <i>Angitta hellulac</i> Viereck----- | <i>Spilochalcis side</i> (Walker) |
| <i>Casinaria orgyiae</i> (Howard)----- | <i>Ceratasmicra metcori</i> , new name |

BRACONIDAE

| | |
|--|---|
| <i>Meteorus versicolor</i> (Wesmael)----- | <i>Spilochalcis side</i> (Walker) |
| <i>Meteorus hyphantriae</i> Riley----- | <i>Ceratasmicra meteori</i> , new name |
| <i>Meteorus laphygmae</i> Viereck----- | <i>Spilochalcis pallens</i> (Cresson) |
| <i>Meteorus</i> sp----- | <i>Ceratasmicra meteori</i> , new name |
| | <i>Ceratasmicra immaculata</i> (Cresson) |
| <i>Rogas laphygmae</i> Viereck----- | <i>Spilochalcis pallens</i> (Cresson) |
| <i>Apanteles griffini</i> Viereck----- | <i>Spilochalcis albifrons</i> (Walsh) |
| <i>Apanteles lacteicolor</i> Viereck----- | <i>Spilochalcis albifrons</i> (Walsh) |
| <i>Apanteles militaris</i> (Walsh)----- | <i>Spilochalcis side</i> (Walker) |
| | <i>Spilochalcis albifrons</i> (Walsh) |
| <i>Apanteles marginiventris</i> (Cresson)----- | <i>Spilochalcis hirtifemora</i> (Ashmead) |
| | <i>Spilochalcis pallens</i> (Cresson) |
| <i>Apanteles congregatus</i> (Say)----- | <i>Spilochalcis albifrons</i> (Walsh) |
| <i>Apanteles delicatus</i> Howard----- | <i>Ceratasmicra meteori</i> , new name |
| <i>Apanteles atalantae</i> (Packard)----- | <i>Spilochalcis albifrons</i> (Walsh) |
| <i>Apanteles</i> sp----- | <i>Spilochalcis side</i> (Walker) |
| | <i>Spilochalcis hirtifemora</i> (Ashmead) |
| | <i>Ceratasmicra meteori</i> , new name |

DIPTERA

STRATIOMYIDAE

| | |
|---------------------------------------|-------------------------------------|
| <i>Odontomyia vertebrata</i> Say----- | <i>Chalcis canadensis</i> (Cresson) |
| <i>Odontomyia</i> sp----- | <i>Chalcis barbara</i> (Cresson) |
| | <i>Chalcis canadensis</i> (Cresson) |

SYRPHIDAE

| | |
|--|---|
| <i>Mesogramma polita</i> (Say)----- | <i>Spilochalcis hirtifemora</i> (Ashmead) |
| <i>Mesogramma polygonastyla</i> (Metcalf)----- | <i>Spilochalcis hirtifemora</i> (Ashmead) |
| <i>Platycheirus</i> sp----- | <i>Spilochalcis hirtifemora</i> (Ashmead) |



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NEW GENERA AND SPECIES OF ICHNEUMON-FLIES, WITH TAXONOMIC NOTES

By R. A. CUSHMAN

THIS paper consists of the description of two new genera and nine new species of ichneumon-flies, together with some notes on synonymy, generic transfers, and the renaming of a genus the old name of which is preoccupied. Also included is a key to the species of the genus *Cryptohelcostizus* Cushman. The figures are from drawings by Mrs. Mary Foley Benson.

Genus POLYCYRTUS Spinola

POLYCYRTUS BICOSTATUS, new species

In my general key to the species of *Polycyrtus*¹ this species will run best to *erythrosterneus* Cameron, but it has the propodeum of entirely different form and differs by many other details of structure and color. In my key to species examined (p. 2) it runs to the second alternate of couplet 7 but differs from all the species falling in that category in the form of the apical carina, which is broadly transverse, instead of angulate, medially.

Female.—Length 11 mm., antenna 9 mm., ovipositor sheath 3.5 mm.

Vertex in front view flat and at the same level as upper eye margins; frons polished, scrobes moderately deep, horn very short conical, without basal pits or tubercle; eyes parallel within, comprising nearly two-thirds total width of head; inner orbits very finely shagreened

¹Proc. U. S. Nat. Mus., vol. 78, art. 14, p. 53, 1931.

and subopaque; face sparsely, weakly punctate, slightly elevated medially; clypeus moderately convex; malar space shagreened, nearly as long as basal width of mandible; cheeks in front view nearly straight; mouth as broad as face; occipital carina convergent above with posterior margin of eye, complete to hypostomal carina, not elevated below; temples in dorsal view weakly convex, hardly a third as long as short diameter of eye. Pronotum polished, posterior groove weakly foveolate, epomia distinct only in middle, anterior lateral carina weak; humeral margin only slightly tumid; mesoscutum polished, with scattered punctures anteriorly, prescutum low and broad; scutellum rather broad and weakly convex, polished; mesopleuron sparsely punctate, prepectal carina complete, the groove foveolate, subalar tubercle rather low; lower division of metapleuron very sparsely punctate, upper division more densely so; propodeum with both transverse carinae complete and strong and with a well-defined basal area and a large obsoletely defined hexagonal areola, both transverse carinae arched forward and transverse medially, apical carina prominent at angles, petiolar area with radiating rugae; pleural carina distinct, with foveolate grooves above and below. Hind femur rather slender, inner calcarium nearly half as long as basitarsus. Areolet small, the lumen hardly as broad as the surrounding veins, recurrent at middle; nervulus antefurcal, postnervulus broken slightly below middle, nervellus broken at lower third. Abdomen polished, first segment rather strongly decurved, second tergite less than three times as long as broad at base, distinctly shorter than first; sheath as long as hind tibia.

Head black, face medially and clypeus reddish; anterior orbits throughout, a spot on malar space, top of clypeus, labrum, and mandibles whitish; palpi stramineous; antenna black with an incomplete annulus occupying flagellar joints 5-14 white; thorax anteriorly and dorsally black, posteriorly and ventrally ferruginous, the black embracing the pronotum, mesoscutum, postscutellum medially, and upper angle of mesopleuron; humeral margins of pronotum, scutellum except apex, subalar tubercle, and tegulae whitish; legs ferruginous, with all tibiae and tarsi and front trochanter yellowish; hind femur largely and trochanter dorsally black to piceous, the femur more reddish below and basally; wings hyaline, venation blackish; abdomen black with petiole and narrow margins of tergites ferruginous, venter yellow.

Type locality.—Chancha Mayo, Peru.

Type.—U.S.N.M. No. 5349.

One specimen taken in September 1928 by G. N. Wolcott.

Genus **HOPLOCRYPTUS** Thomson**HOPLOCRYPTUS BITUMINOSUS** (Cushman), new combination

Cryptoides bituminosus CUSHMAN, Proc. U. S. Nat. Mus., vol. 60, art. 4, p. 6, 1924.

Since its publication this species has been received several times in small numbers, reared from *Pyrausta nubilalis* (Hübner) at Belmont, Mass., and New Haven, Conn.; from *P. penitalis* (Grote) at Bono, Ohio; from *P. ainsliei* Heinrich at York, Ind., and Bono, Ohio; and from *Diatraea* at Grand Isle, La. Other localities, without rearing data, are Nantucket, Mass., Englewood, N. J., and Baton Rouge, La.

Among these specimens are several examples of the undescribed male. This sex differs from the female in the usual secondary sexual characters of smaller size, more slender form, especially of the abdomen, and more slender, longer, and apically tapering antennae. The head is a little broader behind the eyes and the wings a little less deeply infumate.

Genus **CRYPTOHELCOSTIZUS** Cushman

The receipt of specimens of two undescribed species brings to four the number of North American species referable to this genus. They may be distinguished by the following key:

1. Areolet large, first intercubitus more than half as long as second recurrent; wings deeply infumate..... dichrous Vierock
 Areolet small, first intercubitus not or barely half as long as recurrent; wings hyaline or dilutely infumate..... 2
2. Legs in female and hind tibia in male largely black; postscutellum black; wings in female dilutely infumate.... chrysobothridis, new species
 Legs in both sexes, except coxae and trochanters, red; postscutellum white; wings hyaline..... 3
3. First abdominal segment entirely red; posterior orbital mark very narrow and not contiguous with eye; scutellum and coxae immaculate black and propodeum usually so; tegula white only at base..... alamedensis (Ashmead)
 First abdominal segment black with apex red; posterior orbital mark very broad and contiguous with eye; scutellum, propodeum, and coxae conspicuously white-marked; tegula entirely white..... ornatus, new species

CRYPTOHELCOSTIZUS ALAMEDENSIS (Ashmead)

Cryptus alamedensis ASHMEAD, Proc. U. S. Nat. Mus., vol. 12, p. 409, 1890.

Cryptohelcostizus rufgaster CUSHMAN, Proc. U. S. Nat. Mus., vol. 55, p. 534, 1919.

Cryptohelcostizus alamedensis (Ashmead) CUSHMAN, Proc. U. S. Nat. Mus., vol. 60, art. 21, p. 7, 1922. Synonymy of *rufgaster* with *alamedensis*.

Additional reared specimens, all from larvae of Buprestidae, confirm the host record published with the description of *rufgaster* and

cast doubt on the record of Ashmead "from an unknown lepidopterous host." Also all specimens of the two new species described below were reared from buprestids.

The following specimens have been received since the publication of *rufigaster*: 2 females and 2 males reared from *Chrysobothris mali* Horn at Stanford University (May 15, 1922), Los Gatos (May 23, 1918), and Simla Station (June 28, 1922), Calif., under Hopkins U. S. Nos. 16065 a 3, 15913 B 1, and 16634 a, respectively; one female "from flathead borer on *Malus* sp.," Chico, Calif., February 15, 1912, J. R. Horton; and one female, Corvallis, Oreg., April.

CRYPTOHELCASTIZUS DICHROUS Viereck

Cryptohelcastizus dichrous VIERECK, Psyche, vol. 28, p. 73, 1921.

Distinct from all the other species in the deeply infumate wings and large areolet. Viereck failed to note the red hind femora in the male.

Before me are females from Manumuskine, N. J., April 29 and October 21, 1901, and Virginia Beach, Va., October 18, 1922 (Jones-Walker-Brannon); and males from Texas (Belfrage) and Conover, N. C., October 8, 1919 (J. E. Eckert), the last compared by me with the allotype.

CRYPTOHELCASTIZUS CHRYSOBOTHRIDIS, new species

Structurally very like *alamedensis* Ashmead, but so distinct in color, especially of the legs, as to appear specifically distinct.

Female.—Length 12 mm., antenna 9 mm., ovipositor sheath 4 mm. Black, with abdomen, except petiole, ferruginous, and with the following whitish markings: Narrow lines in frontal and posterior orbits (the latter not contiguous with eye) and rarely a triangular mark on cheek, narrow transverse streak on clypeus, incomplete annulus on flagellar joints 8 and 9, and rarely the humeral margin of pronotum and a small spot on base of tegula; flexor surface of front tibia reddish; hind femur basally more or less pale or reddish above; joints 3 and 4 of hind tarsus reddish; wings distinctly, though not deeply, infumate.

Male.—With all white markings of female, except antennal annulus, and also with facial orbits, spot on base of each mandible, and joints 3 and 4 of hind and middle tarsi white; front and middle legs beyond trochanters and the hind femur largely or entirely ferruginous.

Host.—*Chrysobothris* sp. on apple.

Type locality.—Stillwater, Okla.

Type.—U.S.N.M. No. 53492.

Ten females and five males, all reared by Myron Maxwell, March 16–April 8, 1936.

CRYPTOHELICOSTIZUS ORNATUS, new species

This species also is very closely related to *alamedensis*, but may be distinguished from that and from both the other species by its highly ornamented head and thorax. In the following description only those characters are given by which it differs from *alamedensis*.

Female.—Length 11 mm., antenna 7.5 mm., ovipositor sheath 3 mm.

Face mostly polished and sparsely punctate, combined length of face and clypeus fully as long as width of face (distinctly shorter in *alamedensis*); interfoveal line hardly longer than foveo-ocular line (much longer in *alamedensis*); temples convex; ocellocular line much shorter than postocellar line and a little longer than diameter of an ocellus (in *alamedensis* the postocellar and ocellocular lines are nearly equal and nearly twice as long as the diameter of an ocellus); apical joint of antenna tapering slightly (cylindrical in *alamedensis*); first tergite a little more slender than in *alamedensis*, with spiracles slightly beyond middle; spiracles of second tergite at middle (distinctly before middle in *alamedensis*); sheath of ovipositor much less than half as long as body.

White markings of head and thorax much larger than in *alamedensis*; orbital ring very broad and only narrowly interrupted on vertex and malar space, contiguous with eye posteriorly and broadening below to embrace nearly entire width of cheek; antennal annulus on flagellar joints 7–9; collar and both upper and lower margins of pronotum broadly white, as are also the subalar tubercle, tegulae, apex of scutellum, postscutellum, two large lateral spots and a small median spot at apex of propodeum, upper surfaces of all coxae largely, and basal joints of front and middle trochanters except dorsally (coxae and basal trochanteral joints otherwise black); first tergite black, with apex broadly ferruginous and with the extreme apex medially yellow.

Host.—*Chrysobothris deserta* Horn in desert holly.

Type locality.—Death Valley, Calif.

Type.—U.S.N.M. No. 53493.

One specimen reared February 23, 1939, by M. F. Gilman.

APOTEMNUS, new genus

The proper position for this unusual genus, whether in the Phygadeuonini or in the Hemitelini, is very doubtful. In none of the keys to the Phygadeuonini will it run to any genus that even remotely resembles it in general form. Because of its slender antennae, hairy face, and distinct notaulices it runs best to *Panargyrops* Foerster, but beyond these characters and its bidenticulate clypeus it has little in common with that genus. In the keys of Foerster and Ashmead to the Hemitelini it runs directly to *Isadelphus* Foerster,

with which it agrees in many features of the head, thorax, and appendages. From both these genera it differs remarkably in the abruptly truncate propodeum and the stout, *Pimpla*-like abdomen with very short first segment and transversely impressed tergites 1-4.

Female.—Head transverse; temples narrow, ocelli small; eyes divergent below; malar space long; face and clypeus with dense, short, silvery hair; clypeus weakly separated, minutely bidenticulate; mandible evenly bidentate; antenna slender, basal three joints of flagellum very long.

Thorax stout; epomia distinct; notaulices rather deep anteriorly, obsolescent on disk; sternaules deep anteriorly, obsolescent in posterior third; scutellum convex, immargined; metapleuron flat; propodeum broadly truncate, the apical carina thick, prominent laterally, costulae and basal portions of median carinae obsolete, all other carinae absent, spiracles very small, circular; legs moderately stout, hind femur tapering from basal fourth to apex; stigma narrow, with radius somewhat beyond middle; areolet pentagonal, second intercubitus largely bullated; nervulus postfurcal; second discoidal cell with apical angle acute; postnervulus broken far below middle; nervellus broken far below middle and strongly inclivous.

Abdomen stout; first tergite nearly as broad as long, the sides widely divergent to spiracles, thence more gradually divergent, a shallow subapical transverse impression, petiole broadly flattened, tergite in profile nearly rectangular above, dorsal carinae strong to summit of elevation, spiracles a little behind middle; other tergites strongly transverse, apices tumid; tergites 2-4 with broad transverse impressions, those of 2 and 3 with a small low tubercle at each end; ovipositor slender, compressed, narrowly subsagittate at apex, sheath much shorter than abdomen.

Genotype.—*Apotemnus truncatus*, new species.

APOTEMNUS TRUNCATUS, new species

FIGURE 15

Female.—Length 8 mm., antenna 6 mm., ovipositor sheath 2 mm.

Head polished; face and clypeus very finely and densely punctate and mat; face more than twice as broad as long; temple convexly, sharply sloping; malar space as long as basal width of mandible; antenna 24-jointed, basal two joints of flagellum equal and each about six times as long as thick, all other joints at least a little longer than thick.

Thorax polished, with short, fine, appressed pubescence, humeral portion of pronotum, mesoscutum along margins and on middle of disk, scutellum, lower portion of mesopleuron, mesosternum, and

metapleuron minutely punctate; propodeum basad of carina polished, laterally minutely punctate; apical truncature weakly, transversely rugulose, shining.

Abdomen shining, weakly and minutely alutaceous, with fine sparse punctation; ovipositor sheath hardly as long as first two tergites.

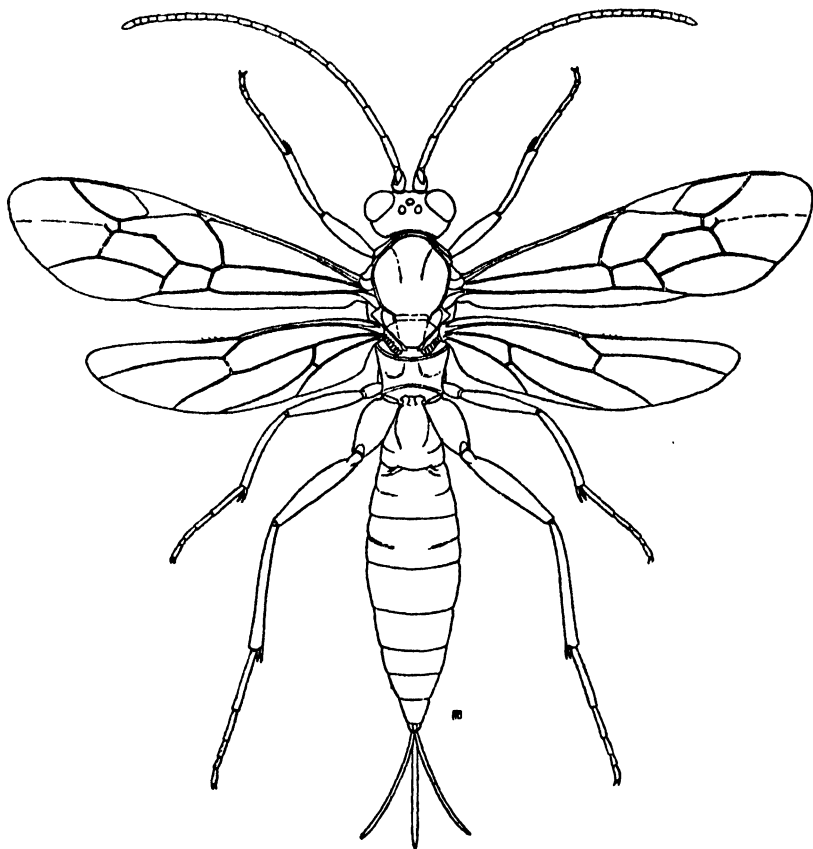


FIGURE 15.—*Apotemnus truncatus*, new genus and species.

Head black; scape reddish in front; mandibles white basally; palpi pale; thorax ferruginous, with black sutures; pronotum and prepectus largely, discal spot on mesoscutum with branches along notaulices and middle of prescutum, an irregular longitudinal spot on middle of mesopleuron, and the propodeum black, the last with a faint, transverse, reddish streak before carina; wings hyaline, stigma and costa stramineous, veins black, tegulae and humeral angles of pronotum white; legs ferruginous, front and middle coxae and trochanters and extensor surfaces of tibiae stramineous; abdomen piceous, darker at bases of tergites and more reddish at apices and

laterally, with tergites very narrowly whitish apically; venter pale, with sternites blackish.

Type locality.—Corvallis, Oreg.

Holotype.—U.S.N.M. No. 53494.

One specimen taken July 13, 1935, by George R. Ferguson.

Genus ITOPLECTIS Foerster

ITOPLECTIS ATROCOXALIS (Cresson)

Pimpla atrocoxalis CRESSON, Trans. Amer. Ent. Soc., vol. 3, p. 146, 1870.

Pimpla ovalis THOMSON, Opuscula entomologica, fasc. 8, p. 748, 1877.—SCHMIEDEKNECHT, Zool. Jahrb., vol. 3, p. 494, 1888; Ill. Wochenschr. Ent., vol. 2, p. 510, 1897; Opuscula ichneumonologica, fasc. 14, p. 1073, 1906.—GEHRM. Deutsche Ent. Zeitschr., 1908, p. 467.—SCHMIEDEKNECHT, Zeitschr. Angew. Ent., vol. 1, p. 414, 1914.—HEINRICH, Deutsche Ent. Zeitschr., 1928, p. 87.—CONSTANTINEAU, Ann. Soc. Univ. Jassy, vol. 15, p. 231, 1928 (1929).—SCHMIEDEKNECHT, Opuscula ichneumonologica, suppl.-band, fasc. 10, p. 96, 1934. New synonymy.

Pimpla (Itoplectis) ovalis THOMSON, Opuscula entomologica, fasc. 13, p. 1409, 1889.—HENSCH, Konowia, vol. 8, p. 127, 1929.

Pimpla maculator var. *ovalis* (Thomson) HAUPT, Mitt. Ent. Ges. Halle, 1913, Nos. 5-6, p. 55.

Itoplectis ovalis (Thomson) MORLEY, A revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 3, p. 78, 1914.—SEYRIG, Eos, vol. 3, p. 217, 1917.

Itoplectis pudibundae ROMAN (not Ratzeburg), Arkiv för Zool., vol. 9, p. 25, 1914.—HELLÉN, Acta Soc. Fauna et Flora Fennica, 1915, p. 39.—SEYRIG, Ann. Soc. Ent. France, vol. 101, p. 116, 1932.

Itoplectis atrocoxalis (Cresson) CUSHMAN, Proc. U. S. Nat. Mus., vol. 58, p. 341, 1920.

Pimpla pudibundae HABERMEHL (not Ratzeburg), Konowia, vol. 9, p. 112, 1930.

The acquisition of more material from both North America and Europe convinces me that *atrocoxalis* and *ovalis* are identical.

Perusal of the original description of *Pimpla pudibundae* Ratzeburg would seem to indicate that Roman was wrong in synonymizing *ovalis* with that species, for *pudibundae* is described as having the ovipositor as long as the abdomen and the hind coxae red-brown. Also Ratzeburg states that he reared his species as a gregarious external parasite, never from the pupa. This is an impossible habit for an *Itoplectis* but is exactly the habit of *Iseropus* and of a few species of *Epiurus*. From the fact that the face of the male of *pudibundae* is not yellow I suspect that it is an *Epiurus*.

Genus CALLIEPHIALTES Ashmead

CALLIEPHIALTES FERRUGINEUS, new species

In my recently published key to the Neotropical species of *Calliephialtes*² this species runs to *minutus* (Brullé). From that species

² Rev. Ent., vol. 9, pp. 96-97, 1938.

it is immediately distinguishable by its red head and red, not yellowish, scutellum and abdomen.

Female.—Length 8 mm., antenna 6 mm., ovipositor sheath 8 mm.

Head and thorax polished, unsculptured, and glabrous, except that the face is sparsely and the propodeum very sparsely hairy and the clypeus bears several long hairs; temple strongly convex but not reaching outside tangent of eye; eyes slightly convergent below and shallowly emarginate opposite antennae; face as long as broad, with a low, median, longitudinal elevation; malar space very short, antenna 30-jointed.

Thorax stout; prescutum medially impressed; notaulices weakly defined on disk of mesoscutum; carinae limiting scutellar fovea obsolete; propodeum without trace of carinae.

Abdomen broad, finely and not densely punctate, tergal tubercles prominent, the impressions defining them posteriorly extending almost across tergites; tergite 1 hardly as long as broad, somewhat tumid, without carinae beyond the very short anterior basin; tergite 2 as long as broad at base, with deep, transverse gastrocoeli; ovipositor sheath with short hair.

Ferruginous; a small spot on each side of apex of propodeum, narrow apical margins of tergites 2-5, more or less broadly interrupted medially, and last two tergites black; antenna black, scape and pedicel partly pale in front; palpi and legs whitish, coxae, trochanters, and femora posteriorly brownish black, as are also the base and apex of the hind tibia; apical joints of tarsi and apices of other joints more or less deeply brown; wings hyaline, venetian black; ovipositor sheath black.

Host.—*Pectinophora gossypiella* (Saunders).

Type locality.—Boqueron, Puerto Rico.

Holotype and paratype.—U.S.N.M. No. 53495.

Two females reared May 20, 1938, by K. A. Bartlett under Puerto Rico No. 1991.

Genus TROMATOBIA Foerster

TROMATOBIA LATERALIS (Cresson), new combination

Clitopyga? lateralis CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 34, 1865.
Ephialtes cressonii DEWITZ, Berlin. Ent. Zeitschr., vol. 25, p. 205, pl. 5, fig. 9, 1881.

This West Indian species is represented by specimens from both Puerto Rico and Cuba as well as by a female taken by P. W. Fattig at Atlanta, Ga., April 14, 1929. One of each sex was reared from a spider egg-cocoon from Lares, Puerto Rico, September 8, 1921, by G. N. Wolcott.

Genus **EXETASTES** Gravenhorst**EXETASTES RUFIPES** Cresson

Exetastes abdominalis var. *a* CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 277, 1865.

Exetastes rufipes CRESSON, Proc. Ent. Soc. Philadelphia, vol. 4, p. 277 (note), 1865.

Exetastes purpureus CUSHMAN, Proc. U. S. Nat. Mus., vol. 84, p. 285, 1937.
New synonymy.

Additional material received since the publication of my revision of *Exetastes* shows *purpureus* to be merely a variation of *rufipes*. This material consists of six females and two males submitted for identification by George R. Ferguson, Oregon State Agricultural College, Corvallis, Oreg. They were collected July 20 and 26, 1937, at 7,000 and 8,500 feet on Steens Mountain, Oreg., by Bolinger and Jewett.

The series includes specimens intermediate in color of legs between the black of *purpureus* and the red of *rufipes* as well as specimens typical of each.

EXETASTES PILOSUS, new species

In my key to the North American species of *Exetastes*³ this species will run to couplet 4, where it agrees with the first alternate in the sculpture and pubescence of the head and thorax but disagrees with the other three characters. The color pattern of the head and thorax is like that of *lasius*, but the abdomen and legs are ferruginous. Beyond couplet 4 it runs, on most of the characters, to *bituminosus* Cushman, with which it agrees rather remarkably in the structure of the head and the form of the abdomen, but differs in the exceedingly slender antennae and legs as well as conspicuously in color.

Female.—Length 11 mm., antenna 11 mm.

Head and thorax mat, with very fine dense punctation and dense silvery pubescence; temples strongly receding, nearly flat; occipital carina sinuate below and joining hypostomal carina; ocellocular and postocellar lines about equal and each much longer than diameter of an ocellus; face twice as broad as long, as broad as length of the parallel eyes, nearly flat, with a small median prominence; clypeus slightly less than twice as broad as long, strongly rounded at apex, transversely divided at basal third, apical part shining, finely shagreened; malar space two-thirds as long as basal width of mandible; mandible nearly twice as long as broad at base, teeth equal; antenna 73-75-jointed, extremely slender filiform, basal joint of flagellum fully six times as long as thick at apex but hardly twice as long as second, subapical joints moniliform.

³Proc. U. S. Nat. Mus., vol. 84, p. 249, 1937.

Thorax rather slender; notaulices absent; scutellum narrow, not at all margined; propodeum with carinae, but separated from metapleuron by a distinct but uneven pleural carina, spiracles small.

Legs extremely slender, hind femur fully nine times as long as deep and fully three-fourths as long as tibia; inner calcarium half as long as basitarsus; claws slender, entirely without teeth; coxae with sculpture and vestiture like thoracic.

Wings: Apical abscissa of radius strongly curved, hardly a half longer than basal abscissa; second recurrent very strongly curved, subangulate near top; nervulus slightly postfurcal; abscissula twice as long as intercubitella.

Abdomen slender, compressed but not deep at apex, subpolished, subtly shagreened and with scattered small punctures basally, polished and unsculptured apically; first tergite twice as long as broad, widening almost evenly from base to apex; second a little longer than broad at base; ovipositor straight, sheath slightly shorter than first tergite.

Head and thorax black; mandible medially, transverse ridge of clypeus (sometimes the apical portion), and collar whitish; apex of clypeus, anteroventral and upper margins of pronotum partly, notaulices and lateral margins of mesoscutum, scutellum laterally and apically, postscutellum, tegula, subalar tubercle, and apices of propodeum and metapleuron yellow to yellowish ferruginous; legs ferruginous, coxae and trochanters black, front and middle ones reddish below, hind coxa reddish piceous above, hind tarsus black; wings hyaline, venation black, stigma pale at extreme base; abdomen bright ferruginous, epipleura and sternites of segments 1-3 edged with black, plica dusky testaceous; sheath black.

Male.—Essentially like female, but flagellum distinctly less slender, legs even more slender and abdomen narrower, markings of thorax and legs paler; hind coxa entirely black; genital sheath ferruginous.

Type locality.—Corvallis, Oreg.

Type.—U.S.N.M. No. 53496.

Three females and one male collected October 25, 1935, by G. R. Ferguson.

ATOPOTROPHOS, new name

Atopognathus CUSHMAN, Proc. Ent. Soc. Washington, vol. 21, p. 116, 1919. Preoccupied by *Atopognathus* Bigot (1881) in Diptera.

I am indebted to Dr. Henry K. Townes, Jr., for calling my attention to the preoccupation of my generic name.

ATOPOTROPHOS COLLARIS (Cushman), new combination

Atopognathus collaris CUSHMAN, Proc. Ent. Soc. Washington, vol. 21, p. 117, fig. 1, 1919.

ATOPOTROPHOS BUCEPHALUS (Cresson), new combination

Mesoleptus ? bucephalus CRESSON, Trans. Amer. Ent. Soc., vol. 2, p. 36, 1868.

This Mexican species, known only from the type male, is larger than *collaris* (Cushman), with head relatively a little smaller, malar space shorter, abdomen more slender, and legs somewhat darker.

Genus PHYTODIETUS Gravenhorst**PHYTODIETUS PULCHERRIMUS (Cresson)**

Mesoleptus pulcherrimus CRESSON, Trans. Amer. Ent. Soc., vol. 2, p. 101, male, 1868.

Phytodietus distinctus CRESSON, Trans. Amer. Ent. Soc., vol. 3, p. 106, 1870. New synonymy.

Phytodietus zonatus PROVANCHER, Nat. Can., vol. 6, p. 79, 1874; Petit faune entomologique du Canada, p. 483, female, 1883. New synonymy.

Phytodietus pulcherrimus (Cresson) PROVANCHER, Nat. Can., vol. 12, p. 81, 1880; Petit faune entomologique du Canada, p. 484, male, 1883.

Mesostenus nobilis PROVANCHER, Nat. Can., vol. 13, p. 363, 1882; Petit faune entomologique du Canada, p. 785, female, 1883. New synonymy.

Mesoleius telarius PROVANCHER, Additions et corrections au volume II de la faune entomologique du Canada . . . , p. 106, female, 1886. New synonymy.

Mentiscus pulcherrimus CRESSON, Synopsis of the families and genera of the Hymenoptera of America, north of Mexico, p. 219, 1887.

Phytodietus distinctus CRESSON, Synopsis of the families and genera of the Hymenoptera of America, north of Mexico, p. 219, 1887.

Phytodietus nobilis (Provancher) DAVIS, Proc. Acad. Nat. Sci. Philadelphia, 1894, p. 187.

Phytodietus telarius (Provancher) DAVIS, Proc. Acad. Nat. Sci. Philadelphia, 1894, p. 189.

Ctenopelma pulchra ASHMEAD, Trans. Amer. Ent. Soc., vol. 22, p. 198, male, 1896.

Phytodietus pulchra (Ashmead) DAVIS, Trans. Amer. Ent. Soc., vol. 24, p. 340, 1897.

Phytodietus pulcherrimus (Cresson) ROHWER, Proc. U. S. Nat. Mus., vol. 57, p. 462, male, 1920.

Phytodietus distinctus (Cresson) ROHWER, Proc. U. S. Nat. Mus., vol. 57, p. 463, female, 1920.

I have for a long time been convinced of the identity of *pulcherrimus* and *distinctus*. Recently additional evidence of this synonymy has come to hand in the rearing by B. J. Landis August 19-26, 1935, at Columbus, Ohio, from *Loxostege similalis* Guenée, of four females (*distinctus*) and two males (*pulcherrimus*).

Both sexes vary greatly in color, especially the female. In the latter sex the body, with the exception of yellow markings on the orbits, the scutellum and postscutellum, and narrow apices of some of the tergites, may be entirely black, while at the other extreme are specimens with the propodeum, metapleuron, and first three or four tergites largely red and the head, thorax, and abdomen profusely marked with yellow. Between these two extremes all gradations occur.

Genus *OPHION* Fabricius*OPHION BERMUDENSIS*, new species

Of the Neotropical species keyed out by Morley⁴ the present species runs best to *intricatus* Brullé, but that is a much larger and paler species.

Female.—Length 11 mm., antennae 11 mm.

Head thin, the temples strongly receding, convex; posterior ocelli nearly touching the eyes and separated from each other by somewhat less than the diameter of an ocellus; eyes very large, nearly reaching bases of mandibles, strongly emarginate within; face below very slightly broader than frons; convex medially, clypeal foveae deep, clypeus barely extending below lower tangent of eyes, its apex broadly arcuate and with a narrow reflexed margin; mandibles stout, barely a half longer than broad at base; antenna 47-jointed, moderately stout, tapering at apex, all joints of flagellum distinctly longer than thick, the first joint much less than twice as long as second.

Thorax stout, about a half longer than deep; mesoscutum finely and sparsely punctate, notaulices distinct and broad anteriorly, obsoletely indicated well back; scutellum convex, sparsely punctate, margined basally; mesopleuron granularly opaque and indefinitely rugulose below, polished and sparsely punctate above; propodeum opaque, granularly rugulose, completely areolated except that basal median area is not defined and the apical carina is interrupted between the median carinae, the basal carina weaker laterally, as are also the lateral carinae (in some of the other specimens these weak carinae are even weaker almost to the extent of being absent).

Legs stout, the hind femur barely twice as long as coxa and hardly six times as long as deep; apical joint of hind tarsus not longer than fourth.

Wings: Basal abscissa of radius straight, not thickened at base, apical abscissa gently curved and about two and one-half times as long as basal abscissa; basal vein straight; first recurrent nearly erect, ramellus reaching fully halfway to basal vein; intercubitus, second abscissa of cubitus, and second recurrent nearly in the ratio of 1:2:4; nervulus slightly antefurcal; radiella strongly curved at base, basal abscissa nearly as long as apical abscissa; intercubitella about a third as long as basal abscissa of radiella; nervellus strongly broken at or a little above middle, reclivous, its upper abscissa perpendicular.

⁴ Revision of the Ichneumonidae based on the collection in the British Museum (Natural History), pt. 1, p. 54, 1912.

Abdomen barely twice as long as head and thorax; spiracles of first segment at apical two-fifths; second tergite much shorter than first and barely as long as third.

Reddish brown; orbits and vertex whitish; face medially brighter than general body color and clypeus and mandibles ferruginous; antennae ferruginous, scape and pedicel darker; scutellum and thoracic sutures paler than general color; wings hyaline, veins blackish, stigma ferruginous, paler toward apex, tegulae and radices stramineous; legs concolorous with body, the trochanters, tibiae, and tarsi more ferruginous.

Male.—Essentially like female.

Type locality.—Bermuda.

Type.—U.S.N.M. No. 53497.

One female and four males received from Fred M. Schott. Two of the males are a little larger and slightly lighter in color.

Genus IDECHTHIS Foerster

IDECHTHIS PERUVIANA, new species

Very similar to the cosmopolitan *I. canescens* (Gravenhorst), from which it differs principally in the somewhat stouter antennae with the subapical joints shorter than thick and not at all moniliform, the finer and denser punctation of mesoscutum, and the black second tergite with apical angles triangularly ferruginous.

Female.—Length 7 mm., antennae 4 mm., ovipositor sheath 2 mm.

Head opaque, with dense, glittering, silvery pubescence on face, clypeus, sides of frons, temples, and cheeks; temples convexly receding, seen from above half as long as short diameter of eye; diameter of an ocellus distinctly longer than ocellular line and about two-thirds as long as postocellar line; eyes shallowly concave opposite antennae; face very slightly narrower than shortest width of frons; antenna 35-jointed, flagellum of uniform thickness, basal joint hardly four times as long as thick, subapical joints slightly thicker than long, not at all moniliform.

Thorax with vestiture like that of head, opaque; pronotum finely punctate, the scrobe shining and transversely striate; mesoscutum very finely, confluent punctate; scutellum more sparsely and finely punctate; mesopleuron and metapleuron very finely shagreened, with minute sparse punctures, speculum polished, scrobe transversely striate; propodeum overlapping basal half of hind coxae, basally shagreened and punctate, apically transversely rugulose, areola elongate, parallel-sided behind costulae, confluent with petiolar area.

Legs: Hind femur and tibia rather stout, tarsus little longer than tibia, longer calcarium not quite reaching middle of basitarsus.

Wings: Areolet very small, with long petiole; postnervellus broken at middle, nervellus strongly inclivous, unbroken.

Abdomen slender, minutely granular, subopaque; first segment without trace of grooves or foveae, postpetiole nearly twice as broad as petiole; second tergite four times as long as broad at base and much more than twice as broad at apex as at base, spiracles slightly less than three-fifths of way from base to apex; segments beyond third compressed; ovipositor slender, upcurved, sheath a little more than one and a half times as long as first segment.

Black with abdomen beyond second tergite and the femora largely ferruginous; scape and pedicel in front, mandible, palpi, and tegulae yellow; scape and pedicel piceous above, flagellum black; wings hyaline, venation blackish; front and middle coxae and trochanters, apices of their femora, and bases of their tibiae yellow, femora otherwise ferruginous and tibiae and tarsi stramineous; hind coxa black, its apex broadly and trochanter beneath yellow, femur piceoferruginous, tibia and tarsus blackish, the tibia with a trace of yellow at extreme base above, calcaria yellow; first segment entirely black, second black with apical corners ferruginous, other tergites ferruginous more or less blackish above.

Male.—Essentially like female.

Type locality.—Lima, Peru.

Host.—*Mescinia peruella* Schaus.

Type.—U.S.N.M. No. 53498.

Three females and one male reared by Dr. J. Wille under his numbers 318–30, 45–31, and 226–32.

Tribe CREMASTINI

BRACHYSCLEROMA, new genus

Head very thin, sublenticular, temples very strongly receding, sometimes nearly perpendicular to longitudinal axis; ocelli small in both sexes; clypeus more or less distinctly separated from face, apically subacute, with an oblique impression on each side along margin; malar space long; mandible small, upper tooth longer than lower; antennal scape subcylindrical, hardly thicker than flagellum, apex hardly oblique; flagellum setiform, tapering from base to apex, with long, very dense reclinate pubescence and also with erect verticillate hairs at apex of each joint, all joints short, basal joint shorter than scape; palpi of only moderate length and very slender; maxillae of normal length and form.

Thorax very robust; mesoscutum precipitate anteriorly, notaulices not or weakly defined; scutellum strongly margined to apex laterally; mesopleuron with a broad, deep, oblique furrow, usually foveolate at

bottom; sternaules deep, more or less foveolate; propodeum strongly rounded, perpendicular apically, not overlapping hind coxae, completely areolated except that apical abscissa of lateral carina and sometimes costellae are absent.

Legs moderately stout and, especially hind legs, very long; tibiae, especially hind tibia, very coarsely and deeply punctate and with coarse, long hair; claws very small, pectinate, the pecten of each claw composed of two or three slender teeth; calcaria very long, inner one of each pair much longer than outer.

Wings broad, nearly or quite reaching apex of abdomen; stigma narrow, radius at or slightly beyond middle; basal vein perpendicular, curved; metacarpus much longer than stigma; areolet small, oblique, recurrent near apex; discocubitus sharply curved or broken basad of bulla; recurrent straight, bulla weakly divided; nervulus broken far below middle; abscissula nearly or quite as long as intercubitella; mediella distinct to base; nervulus broken far below middle and strongly inclivous; longitudinal veins of hind wing obsolete beyond cross veins.

Abdomen relatively short and slender; first segment about as long as next two combined, postpetiole much longer than broad, sternite not reaching spiracles and not at all enclosed by lateral margins of tergite; tergite 2 distinctly shorter than 3, epipleura not carinately separated, spiracles in epipleura; ovipositor long and extremely slender, attenuate apically, apical notch inconspicuous.

Genotype.—*Brachyscleroma apoderi*, new species.

Of the other cremastine genera *Brachyscleroma* is most closely allied to *Dimophora* Foerster, resembling that genus in the short, robust thorax with distinct sternaules; the margined scutellum; the strongly rounded and posteriorly precipitate propodeum not overlapping the hind coxae; the stout, long hind legs; and the short abdomen with relatively long first segment and short second and third segments, the first sternite not at all covered by the lateral margins of the tergite and not nearly reaching the spiracles. Many of the characters common to the two genera are exaggerated in *Brachyscleroma*; the sternaules are deeper and more or less foveolate; the scutellum is margined to apex, not merely at base; the hind legs are relatively longer as compared to the front legs; and the first abdominal segment is relatively longer and the second and third segments are relatively shorter. Otherwise *Brachyscleroma* differs from *Dimophora* by most of the features mentioned in the description, notably the thin, lenticular head; the deep, oblique mesopleural furrow; the narrow stigma; the small, oblique areolet; the very short second tergite with spiracles in the epipleura, which are not carinately separated; and the very long, slender ovipositor.

The coleopterous host is also unusual for a cremastine.

BRACHYSCLEROMA APODERI, new species**FIGURE 16**

Female.—Length 5 mm., antenna 3 mm., ovipositor sheath 4 mm.

Head more than 2.5 times as broad as thick; temples flat, polished, nearly perpendicular to longitudinal axis; postocellar line longer than ocellocular line and more than twice as long as diameter of an ocellus; frons transversely striatopunctate; face nearly twice as long as broad,

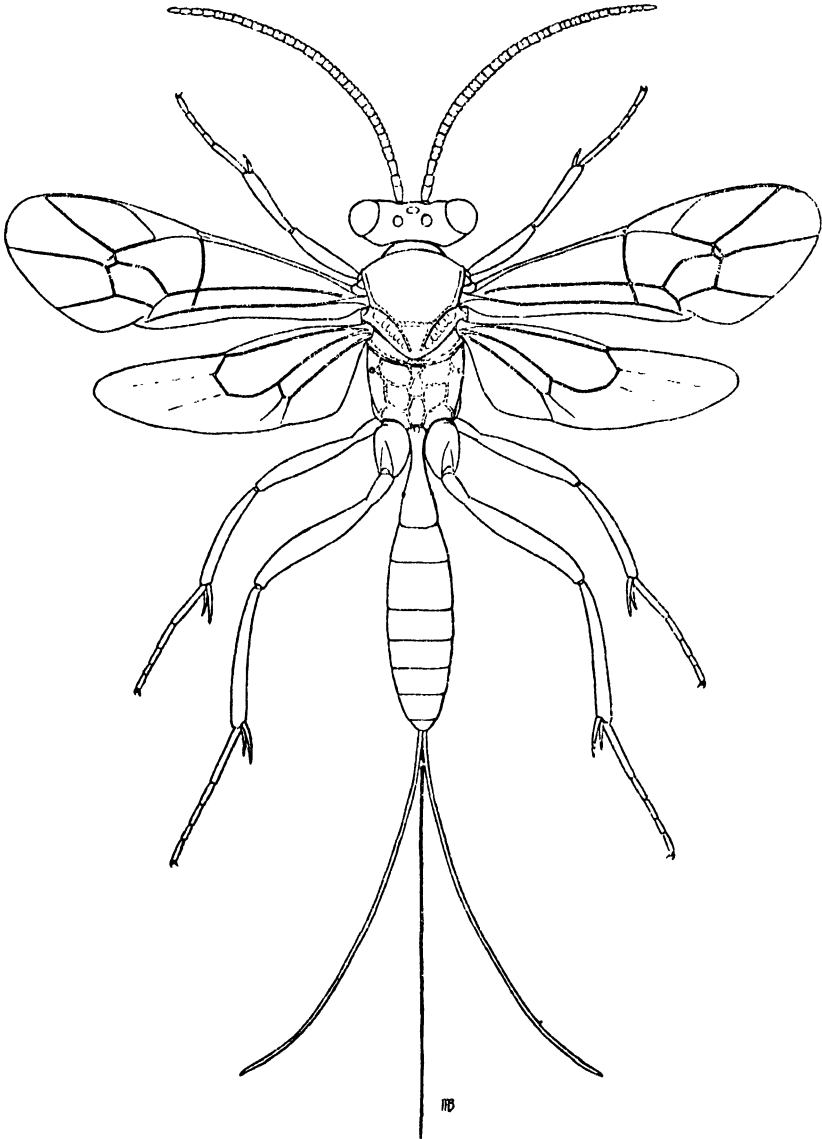


FIGURE 16.—*Brachyscleroma apoderi*, new genus and species.

coarsely, densely umbilicate-punctate, this sculpture extending onto base of clypeus and obscuring the separating furrow; malar space nearly as long as basal width of mandible, rugose before and striate behind malar furrow; scape nearly twice as long as thick, about twice as long as pedicel and much longer than first joint of flagellum; flagellum 27-jointed, fully twice as thick at base as at apex and tapering gradually, the joints successively very slightly shorter from base to apex.

Thorax nearly as deep as long; densely punctate dorsally, mostly polished laterally, with all lateral furrows strongly foveolate; pronotum punctate along humeral margin; notaulices not defined; scutellum more coarsely punctate than mesoscutum, scutellar furrow foveolate; mesopleural furrow and sternalices strongly foveolate; propodeum polished, margins of areas foveolate; median areas narrow, areola pentagonal with costulae behind middle; inner hind calcarium about three-fourths as long as basitarsus; tarsus hardly as long as tibia, basitarsus hardly longer than joints 2 and 3 combined.

Abdomen little more than half as broad as thorax; with dense, long pubescence except on broad, polished, median, apical areas of first three tergites and middle areas of other tergites. Black; mandibles and polished apical portion of clypeus light brownish; palpi white; antenna fuscous, stramineous basally; wings hyaline, venation brown, stigma paler, costa and radix stramineous, tegula testaceous; front and middle legs stramineous; hind coxa piceous, stramineous ventrally, trochanter stramineous, femur and tibia rufo-fuscous, femur paler apically; joints 2-4 of tarsus paler than basitarsus; petiole whitish, postpetiole black; rest of abdomen rufotestaceous, paler toward apex, tergite 2 partly reddish piceous toward apex; ovipositor sheath brownish yellow.

Male.—Very similar to female in both structure and color, but tergites beyond first brownish, with base and sides of second and basal angles of third whitish; genitalia white.

Host.—*Apoderus quadripunctatus* Gyllenhal.

Type locality.—Tjipetir, Java.

Type.—U.S.N.M. No. 53499.

One female and two males reared in 1936 by J. Van der Vecht.

Genus PSEUDERIPTERNUS Viereck

PSEUDERIPTERNUS ELONGATUS (Davis), new combination

Atcleuti (sic!) *elongatus* DAVIS, Trans. Amer. Ent. Soc., vol. 24, p. 362, 1897.

Pseuderipternus gracilipes CUSHMAN, Proc. U. S. Nat. Mus., vol. 53, p. 507, 1917.

New synonymy.

Paratype *a* of *gracilipes* has been compared with the type of *elongatus* and found almost identical.

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THE SCOLYTID BEETLES OF THE GENUS *RENOCIS*
CASEY, WITH DESCRIPTIONS OF NINE NEW SPECIES

By M. W. BLACKMAN

For more than 45 years specimens of undescribed species of *Renocis* Casey have been accumulating in the National Museum owing to the efforts of various collectors.¹ Most of these specimens were collected in the Southwestern States. The species occurring in these arid and semi-arid regions are found in a variety of hosts. Species of the family Rosaceae (*Malus*, *Amelanchier*, *Cercocarpus*, *Cowania*, and *Prunus*) most frequently serve as hosts, but at least three Leguminosae (*Eysenhardtia*, *Prosopis*, and *Parkinsonia*) and in addition species of *Rhus*, *Ribes*, and *Covillea*, and of the genus *Encelia* of the Compositae, are also attacked by one or several species of *Renocis*.

It is doubtful whether any of the species ever breed successfully in the vigorous tissues of their hosts; but as the plants upon which they depend are common in grazing lands, a plentiful supply of injured and broken shrubs or limbs is always available in such areas.

¹ Included among these are E. A. Schwarz, H. G. Hubbard, H. S. Barber, D. W. Coquillett, H. F. Wickham, and A. D. Hopkins, formerly chief of the division of forest insect investigations, U. S. Bureau of Entomology, and his field force, including J. M. Miller, F. P. Keen, H. E. Patterson, W. F. Fiske, J. L. Webb, George Hofer, M. Crissman, and B. T. Harvey. Other specimens have been more recently received from the Southwest through J. N. Knull, T. O. Thatcher, and William Nye, and from Brazil through D. da Rocha. Also several series of a Mexican species have been intercepted by the New York, N. Y., Brownsville, Tex., and Nogales, Ariz., plant quarantine stations of this bureau.

In these semiarid regions, also, many of the host plants are weakened by drought, thus becoming suitable hosts for *Renocis*. Scorching of the host by light ground fires also furnishes suitable breeding material. On the other hand, the beetles' breeding activities in broken limbs and shrubs and in shrubs and small trees weakened by other causes may greatly increase the fire hazard.

While the hosts affected by species of *Renocis* are not usually producers of valuable wood, they are of great use as browse for both wild and domestic herbivora and are valuable in binding the soil on watersheds. Their destruction by fire and insects may result in serious erosion of the watershed, silting of the storage basins, or even disastrous landslides. Several species of *Renocis* are also known to attack fruit trees and shrubs, but they are not known to be really destructive in well-kept orchards.

Drawings for the figures herein were made under the author's supervision by Mrs. Eleanor A. Carlin, of the United States Bureau of Entomology and Plant Quarantine.

Genus RENOCIS Casey

Renocis CASEY, California Acad. Sci. Bull. 6, pp. 257-259, 1886.—SWAINE, New York State Mus. Bull. 134, p. 144, 1909; Canada Dept. Agr. Ent. Branch, Bull. 14, pt. 2, p. 39, 1918.—BRUCK, Bull. Southern California Acad. Sci., vol. 35, pt. 1, p. 41; pt. 2, pp. 119-120, 1936. (Genotype, *Renocis heterodoxus* Casey.)

Pseudocryphalus SWAINE, Canada Dept. Agr., Ent. Branch, Bull. 14, pt. 1, p. 20, 1917; pt. 2, pp. 40, 57, 1918.—BRUCK, Bull. Southern California Acad. Sci., vol. 35, pt. 1, p. 35; pt. 2, pp. 121-123, 1936. (Genotype, *Pseudocryphalus brittanni* Swaine.)

Description.—Body stout, usually less than twice as long as wide. Head deflexed, slightly visible from above; frons concave in male at least, with longer, coarser setae at sides and above; antennal funicle 5-jointed, club compressed, often elongate, with three annulate-setigerous sutures; eyes elongate, sinuate or feebly emarginate in front. Pronotum deflexed, feebly arched, much wider than long, strongly narrowed in front, anterior margin usually unarmed, but with a fringe of erect setae, not sharply margined at sides, clothed in recumbent scales, with two or three small groups of asperities on disk at each side; scutellum lacking. Elytra with base strongly elevated and with coarse crenulations; punctate striate; interspaces clothed with recumbent scales, with a median row of erect setae on each; declivity unmodified, impressed or sulcate. First and second abdominal sternites subequal, each as long as third and fourth united; prosternum short but always present, partly or wholly concealed by the bulbous forecoxae; marginal teeth on foretibia varying with species from long and slender to short and stout.

Remarks.—Casey's description of the genus *Renocis* and the species *heterodowus* was based upon a single specimen, and this not in perfect condition. This precluded the making of dissections and special mounts of parts that are essential in the proper study of such small insects. For this reason Casey's original description of *Renocis* may be modified and amplified in several respects.

On page 257 Casey says, "Anterior coxae in contact with the head beneath; prosternum entirely obsolete before them." Dissection demonstrates that the prosternum is always present (fig. 17, *a*) though rather narrow, and although it is concealed by the bulbous forecoxae in the entire specimen, its presence may be inferred with certainty by the very evident white setae, arising from the edge of the prosternum, which may be seen, even in the type, between the coxae and the head. He also described the teeth on the outer margin of the foretibia as "short, very robust spinules." As shown by figure 18, *e*, these are neither short nor very robust as compared with those of many other scolytids. Also the antennal club in *Renocis heterodowus* only appears to be "longer than the entire preceding portion." Actually it is considerably shorter (fig. 17, *h*).

It seems certain that Swaine's genus *Pseudocryphalus* would not have been proposed had Casey's description been more accurate, for the main characters in which his description differs from that of Casey have to do with the prosternum and the tibial teeth. Indeed, Swaine's description of *Pseudocryphalus* applies very closely to the type species of *Renocis*—much more closely than Casey's description.

LeConte's genus *Chaetophloeus* (figs. 17, *q*; 18, *o*), represented by the single species *C. hystrix* LeConte, is similar to *Renocis* in several respects such as body form and proportions, general structure of the frons, antennae, and eyes, and the strongly elevated and crenulate anterior margins of the elytra. It differs, however, in that the third joint of the tarsus is wider and distinctly emarginate; the pronotum is not strongly deflexed and its anterior margin does not have a fringe of specialized, coarse, erect setae; and the punctures throughout are coarse, deep, and close and give rise to erect, hairlike setae.

The genus *Renocis* as here constituted includes species that are strikingly different in superficial aspects and that indeed show differences in certain structures that in other groups might warrant including the species under several different genera. However, a careful study of both entire and dissected specimens shows that in the essential characters mentioned in the revised generic description the necessary uniformity exists. Forms as dissimilar superficially as *parkinsoniae*, *penicillatus*, and *braziliensis* show all the essential generic characters found in the type species, *heterodowus*.

In the following key to the species of *Renocis* the chief consideration has been to make it useful in the ready separation of the species, rather than to attempt to express genetic relationships. If the latter purpose were to be considered of primary importance, it is felt that such species as *heterodoxus*, *commiatus*, *britannia*, *criddlei*, and *brunneus* should perhaps be placed closer together. With these probable relationships ignored it is believed that a more workable key has resulted.

KEY TO THE SPECIES OF RENOCIS CASEY

1. Frons of female feebly to moderately impressed or concave, that of male more strongly concave; disk of elytra with median row of long erect setae in each interspace; declivity impressed or sulcate in sutural region----- 2
 - Frons of female flat, that of male strongly, broadly concave; elytra with median row of setae in each interspace erect, but short, wide, and often scalelike; declivity not impressed or sulcate in sutural region----- 11
2. Base of pronotum procurved or deeply, broadly emarginate; elytral declivity strongly sulcate between the elevated third interspaces, with median rows of setae much reduced or lacking in first and second interspaces----- 3
 - Base of pronotum procurved or shallowly emarginate; elytral declivity impressed or weakly sulcate in sutural area, with median rows of setae present in all interspaces----- 5
3. Large and stouter, about 1.7 times as long as wide; antennal club (fig. 17, *b*, *c*) very large and slender, 3 times as long as wide, distinctly longer than scape and funicle combined; pronotum with 3 groups of small, slender asperities at each side; anterior margins of elytra strongly elevated and serrate with median portion displaced posteriorly; declivity deeply and broadly sulcate, with setae in interspaces 3, 5, 7, and 9 more numerous, very large, terete; foretibia (fig. 18, *a*, *b*) with 9-14 teeth----- *parkinsoniae*, new species (p. 378)
 - Smaller and less stout, at least 1.8 times as long as wide; antennal club (fig. 17, *d*) shorter than scape and funicle combined, less than 2.5 times as long as wide; pronotum with 2 groups of sharp asperities at each side; anterior margins of elytra strongly elevated and serrate, forming a continuous line; declivity broadly shallowly sulcate, with setae except in interspaces 1 and 2 moderately larger, spatulate; foretibia with fewer, slender teeth (fig. 18, *c*)----- 4
4. Frons with a low, granulate tubercle at each side of median line; pronotum with dark-brown scales forming a diamond-shaped median marking and an oblong spot at each side of disk; elytra with sutural light stripe and alternate fasciae of brown and of white scales; body form twice as long as wide----- *maclayi* (Bruck) (p. 382)
 - Frons with sides finely granulate-punctate, without tubercle; pronotum with cinereous and light-brown scales, the latter forming an oblong spot at each side of disk; elytra with uni-

- formly cinereous scales, with no evidence of fasciae; stouter, about 1.8 to 1.85 times as long as wide.-----pruinosis, new species (p. 383)
5. Declivity subsulcate, with first and second interspaces broad and nearly flat; pronotum with 2 groups of asperities at each side.----- 6
- Declivity with first striae more strongly impressed, suture elevated, second interspaces convex; pronotum with 2 or 3 groups of asperities at each side.----- 8
6. Smaller and stouter, about 1.75 times as long as wide; base of pronotum broadly, moderately deeply emarginate, with emargination bisinuate; front margin not bisinuate; elytra with median portion of serrate anterior margin displaced posteriorly; cinereous scales forming fascia across middle of elytra.
fasciatus, new species (p. 385)
- Larger and not so stout, more than 1.8 times as long as wide; base of pronotum broadly procurved, with median portion not bisinuate; front margin bisinuate; elytra with serrate anterior margin bisinuate, forming a continuous line; with no fascia of light scales across middle of elytra.----- 7
7. Piceous-brown to black; with dark-brown and cinereous scales; frons often with coarse granule or tooth at each side; anterior tibia with 8 teeth on outer margin (fig. 18, e).
heterodoxus Casey (p. 387)
- Reddish brown; with cinnamon-brown and cinereous scales; frons granulate-punctate at sides, without special granule or tooth; anterior tibia with 10 teeth on outer margin (fig. 18, f).
brunneus, new species (p. 389)
8. Pronotum with 2 groups of asperities at each side, base nearly straight; elytra stouter, 1.25 times as long as wide, striae distinctly, equally impressed, with first not notably stronger; scales not concealing the surface, with few light ones; foretibia with 8 teeth on outer margin (fig. 18, g).
fuscus, new species (p. 391)
- Pronotum with 3 groups of asperities at each side, base procurved; elytra 1.4-1.5 times as long as wide, striae, except first, rather feebly impressed; scales concealing most of surface, many of them cinereous.----- 9
9. Frons with a subtriangular concavity, the sides granulate-punctate; pronotum with anterior margin feebly sinuate at middle; elytra 1.4 times as long as wide; foretibia with 9-11 teeth on outer margin (fig. 18, h, i)-----commixtus, new species (p. 392)
- Frons feebly concave, with a coarse granule at each side; pronotum with anterior margin broadly emarginate at middle; elytra about 1.5 times as long as wide.----- 10
10. Elytra with striae distinctly, rather strongly impressed, striae punctures rather coarse, deep, and distinct.-----brittaini (Swaine) (p. 394)
- Elytra with striae very feebly impressed, punctures small and closely placed.-----cridlei (Swaine) (p. 395)
11. Pronotum at base with sinuate emargination, with a pencil of long fine setae at each side just behind anterior margin, longer and more conspicuous in male; elytra with median portion of serrate anterior margins displaced posteriorly;

- each interspace with a row of conspicuous, erect, broad, scale-like setae; foretibia (fig. 18, *j*) with 6 long, slender teeth on outer margin.....penicillatus Bruck (p. 395)
- Pronotum procurved or emarginate at base, without a pencil of long setae; elytra with the serrate anterior margins forming a continuous line; each interspace with median row of scale-like setae, shorter and inconspicuous; foretibia with stout teeth on outer margin (fig. 18, *k-n*)..... 12
12. Black, almost exactly twice as long as wide, scales and setae mostly piceous with fewer cinereous scales; antenna (fig. 17, *n*) with club very large, more than twice as long as wide, as long as funicle and scape together; pronotum with asperities reduced to granules; elytra with marginal serrations supplemented by a row of 4 teeth just behind margin, 2 on each elytron; striae weakly impressed; foretibia (fig. 18, *k*) with 8 or 9 teeth on outer margin.....mexicanus, new species (p. 397)
- Reddish brown, less than 1.85 times as long as wide, clothed mostly in cinereous scales with a few fulvous ones; antennal club rather large, broadly oval, less than 1.6 times as long as wide, shorter than funicle and scape together; pronotum with asperities slender, but high and sharp; elytra with marginal serrations supplemented or not by a second row; striae distinctly impressed..... 18
13. Antennal club (fig. 17, *o*) 1.58 times as long as wide; pronotum with scales nearly uniformly cinereous; each elytron with a row of 7 or 8 teeth on anterior margin and a single tooth behind this row; foretibia (fig. 18, *l, m*) with 7-9 teeth on outer margin.....braziliensis, new species (p. 398)
- Antennal club (fig. 17, *p*) 1.33 times as long as wide; pronotum with cinereous scales at sides and behind, and fulvous ones on most of disk; each elytron with a row of 8 teeth on anterior margin and no supplementary ones; foretibia (fig. 18, *n*) with 4 short, stout teeth on outer margin.....insularis, new species (p. 400)

RENOCIS PARKINSONIAE, new species

FIGURES 17, *b, c*; 18, *a, b*

Female.—Reddish brown, with most of scales small and with very coarse, erect, nearly white setae; 1.77 to 2.43 mm. long, holotype 2.2 mm. long, 1.7 times as long as wide.

Frons with epistoma subcarinate, shining in median line, with margin produced into a sharp median point, and with a fringe of nearly white slender setae, covering basal half of mandibles; arcuately, transversely impressed above epistoma, with impression widened in the median area to form a broad, short, shallow concavity between eyes, not strongly elevated at sides and above; surface reddish brown, moderately shining, very finely punctate, with interspaces very finely reticulate-granulate, with a few low granules at the sides and above; surface partly concealed by moderately coarse, light cinereous hairs, those at the sides and above being slightly more

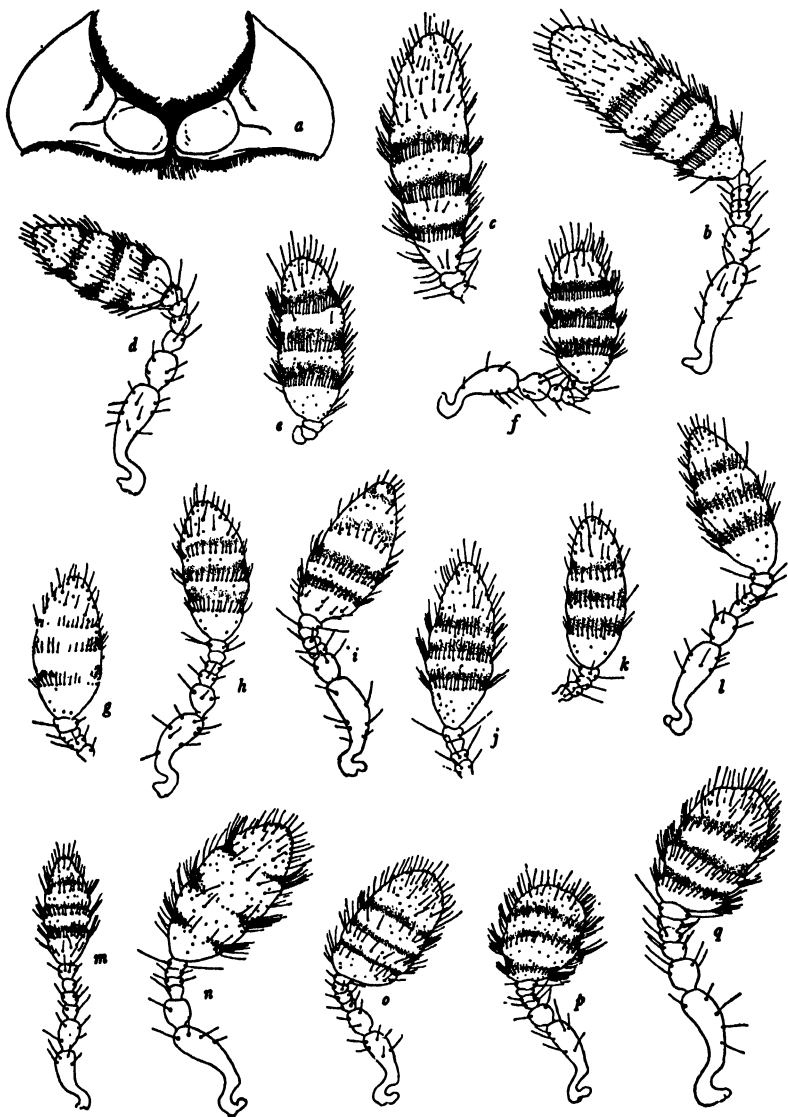


FIGURE 17.—Species of *Renocis* and *Chaetophloeus*. (All drawings except *a* made from balsam mounts of dissections, with the aid of a compound microscope and a camera lucida. *a*, \times ca. 49; all others, \times 79.)

- a*, *g*, *h*, *Renocis heterodoxus* Casey: *a*, Prosternum, with coxae removed from coxal cavities to show presence of short prosternum, which is ordinarily concealed by bulbous forecoxae; *g*, antennal club of female; *h*, antenna of male.
- b*, *c*, *R. parkinsoniae*, new species: *b*, antenna of female; *c*, antennal club of male.
- d*, *R. pruinosis*, new species: Antenna of female.
- e*, *f*, *R. fasciatus*, new species: *e*, Antennal club of male; *f*, antenna of female.
- i*, *R. brunneus*, new species: Antenna of male.
- j*, *R. fuscus*, new species: Antennal club.
- k*, *l*, *R. commixtus*, new species: *k*, Antennal club of male; *l*, antenna of female.
- m*, *R. penicillatus* Bruck: Antenna.
- n*, *R. mexicanus*, new species: Antenna of male.
- o*, *R. brasiliensis*, new species: Antenna of male.
- p*, *R. insularis*, new species: Antenna of female.
- q*, *Chaetophloeus hystrix* LeConte: Antenna.

abundant and coarser. Eye scarcely 3 times as long as wide, finely granulate, inner line sinuate. Antenna (fig. 17, *b*) with club comprising more than one-half of total length, 3 times as long as wide, with three straight, setigerous, annulate sutures, setae slender.

Pronotum 1.53 times as wide as long, widest on posterior third; base with broad, deep, bisinuate emargination; sides strongly arcuate, constricted and transversely impressed just behind front margin, which is very broadly rounded, feebly sinuate in median area; surface reddish brown, finely, closely granulate-punctate; with three groups of rather long, sharp asperities at each side—anterior group, usually 2, just behind anterior margin; middle group, usually 2, back of transverse impression; posterior group, usually 3, on the posterior half; surface nearly concealed by small, stout scales, most of them light cinereous, except for an admixture of fulvous ones on anterior third of disk and extending backward at each side of posterior group of asperities; anterior margin with a fringe of coarse, moderately long setae, shorter in the median line; anterior row of fringe light cinereous, those behind testaceous to fulvous.

Elytra 1.2 times as long as wide, slightly wider than pronotum; sides straight and subparallel on anterior two-thirds, broadly rounded behind and strongly emarginate in median area; basal margins strongly elevated in each elytron from suture to fourth stria; each with six dark-brown teeth, the median three on each side displaced posteriorly, and more or less fused in a crescent-shaped row; striae narrow, moderately impressed except the first, punctures moderately coarse and close; interspaces weakly convex on disk, finely rugose punctate; surface on disk clothed with small, stout, semierect, scalelike, cinereous setae, and in the middle of each interspace a row of longer, erect setae, not flattened but terete, becoming much longer, coarser and blunt behind. Declivity originating just behind middle, sloping, deeply, broadly sulcate between the third interspaces, which are very strongly elevated, with both median and lateral setae very coarse, terete, longer and erect, forming a high ridge each side of sulcus; fifth, seventh, and ninth interspaces less strongly elevated, also with long, coarse setae; sulcus with suture slightly elevated; first striae impressed; second interspace narrow; setae lacking or nearly so in interspaces 1 and 2.

Ventral surface dark reddish brown, shining, sparsely clothed with nearly white, bifurcate scales except on last three abdominal segments; third and fourth segments with erect, fulvous, undivided setae except at sides; last segment as long as third and fourth combined, with erect, fulvous setae. Foretibia with 9–11 rather coarse teeth on outer margin, occasionally with teeth more numerous (fig. 18, *a*, *b*).



FIGURE 18.—Species of *Renocis* and *Chaetophloeus*. (Drawings made from balsam mounts of dissections, with the aid of a compound microscope and a camera lucida. $\times 79$.)

- a, b, *Renocis parkinsoniae*, new species: a, Foretibia and tarsus of female; b, foretibia and tarsus of male.
c, *R. pruinosis*, new species: Foretibia of female.
d, *R. fasciatus*, new species: Foretibia of female.
e, *R. heterodoxus* Casey: Foretibia.
f, *R. brunneus*, new species: Foretibia and tarsus of male.
g, *R. fuscus*, new species: Foretibia.
h, i, *R. commixtus*, new species: h, Foretibia of male; i, foretibia of female.
j, *R. penicillatus* Bruck: Foretibia and tarsus.
k, *R. mexicanus*, new species: Foretibia of male.
l, m, *R. brazilienis*, new species: l, Foretibia of female; m, foretibia and tarsus of male.
n, *R. insularis*, new species: Foretibia and tarsus of male.
o, *Chaetophloeus hystrix* LeConte.

Male.—Similar in size and habitus to female, but with frons more deeply concave and frontal hairs more numerous and longer; antennal club longer and more slender, definitely longer than rest of antenna; anterior margin of pronotum with longer setae; pronotal asperities usually smaller; venter of last abdominal segment slightly shorter, with setae diverging from median line.

Type locality.—Catalina Springs, Ariz.

Additional localities.—Hot Springs and Sabino Canyon, Ariz.

Host.—*Parkinsonia microphylla* Torrey.

Type material.—Holotype, allotype, and 89 paratypes, U.S.N.M. No. 52949.

Remarks.—Holotype, allotype, and 74 paratypes were collected and bred from *Parkinsonia* at Catalina Springs, Ariz., by Hubbard and Schwarz; 3 paratypes from Hot Springs, Ariz., Barber and Schwarz; 12 paratypes collected from *Parkinsonia microphylla* at Sabino Canyon, Ariz., by George Hofer.

RENOCIS MACLAYI (Bruck), new combination

Pseudocryphalus maclayi BRUCK, Bull. Southern California Acad. Sci., vol. 35, pt. 1, p. 35; pt. 2, p. 122, 1936.

Female.—Dark brown, color pattern variegated with dark brown and nearly white scales and setae; paratype 1.82 mm. long, about twice as long as wide.

Frons with a short, sharp, median point on epistomal margin, with a fringe of light yellow-cinereous setae covering more than basal half of mandibles; transversely, arcuately impressed just above epistoma, broadly longitudinally impressed in median line; surface shining, finely, rather closely punctured, with fine, moderately sparse granules over most of surface; with a more strongly granulate, moderate elevation at each side, just mesad of upper angle of eye; surface mostly concealed by rather coarse recumbent and suberect setae, cinereous below and in median line, brown above. Eye about 3 times as long as wide, finely granulate, the inner margin broadly sinuate. Antenna with club slightly more than twice as long as wide, considerably shorter than remaining visible parts, with 3 nearly straight, annulate-setigerous sutures.

Pronotum about 1.5 times as wide as long, widest well in front of base, which is broadly procurved; sides strongly arcuate behind, strongly narrowed anteriorly; constricted and transversely impressed just behind the nearly straight, slightly sinuate front margin; surface dark brown, shining, finely, rather closely punctured, with interspaces minutely reticulate-granulate; with two groups of rather coarse, high asperities at each side; surface clothed with small, wide, recumbent, light-cinereous scales, which are nearly white over most of surface, but are brown in a median, irregular diamond-shaped or

"arrowhead-shaped" spot, and in a smaller, irregular-shaped spot at each side involving both groups of asperities; anterior margin with very sparse fringe of lighter brown, erect setae.

Elytra 1.28 times as long as wide, slightly wider than pronotum; sides subparallel on anterior two-thirds, broadly rounded behind; each basal margin strongly elevated from first to fifth interspace, with 6 coarse crenulations, very coarse nearest suture; striae distinctly but rather weakly impressed, with punctures moderate and fairly close; interspaces nearly flat, finely rugose punctate; surface nearly concealed by numerous small, rather narrow, semirecumbent scales, some of them brown and some very light cinereous; light scales forming the usual sutural stripe, and two broad fasciae, one in anterior half of elytra, the second involving entire face of declivity; each interspace with a median row of erect, broad, spatulate setae, brown or cinereous in color; each elytron with a dense group of erect brow setae just behind the basal elevation. Declivity moderately steep, very broadly sulcate between third interspaces, first and second interspaces flat, nearly devoid of erect median setae; third interspace rather high, with median erect setae more numerous than on disk, forming a partial double row.

Ventral surface dark brown, shining, sparsely clothed with white, recumbent, bifurcate scales, which are suberect on last three abdominal segments. Foretibia with six rather long teeth on outer margin.

Type locality.—Los Angeles County, Calif.

Host.—*Encelia californica* Nuttall.

Type material.—Holotype in collection of C. R. Bruck. Paratypes: Collection of California Academy of Sciences, San Francisco, Calif.; Canadian National Collection, Ottawa, Canada; Los Angeles Museum; collection of A. T. McClay.

Remarks.—The foregoing description was prepared from a paratype of *Pseudocryphalus maclayi* Bruck loaned by the Los Angeles Museum through the courtesy of Dr. John A. Comstock and Dr. W. Dwight Pierce. The paratype bears the data "Westwood Hills, L. A. Co. Cal., I.26.1936; *Encelia californica*; A. T. McClay, Collector." From comparison with other species of *Renocis* it is believed that this paratype is a female. No other specimens have been seen by the writer.

RENOCIS PRUINOSUS, new species

FIGURES 17, *d*; 18, *c*

Female.—Light reddish brown, but appearing pruinose owing to light-cinereous scales; 1.8 to 2.25 mm. long; holotype 2.14 mm. long, 1.85 times as long as wide.

Frons with epistomal margin bearing a median sharp point, with a fringe of cinereous setae covering most of mandibles; with an arcuate transverse impression just behind the epistoma, which is widened in median area to a point well above the eyes, forming a median concavity; elevated at sides and above; surface brown, shining, finely punctate in concavity, finely and closely granulate-punctate at sides and above; clothed with moderately long, rather coarse, testaceous setae, more abundant at sides and above. Eye finely granulate, more than 3 times as long as wide, the inner margin rather weakly sinuate. Antenna (fig. 17, *d*) with club 2.22 times as long as wide, shorter than the remaining visible part of antenna, with 3 nearly straight sutures marked by annuli and rows of setae.

Pronotum about 1.4 times as wide as long, widest near base, which is broadly, shallowly emarginate; sides strongly arcuate from base to transverse impression just behind anterior margin, which is feebly, broadly sinuate in median area; surface reddish brown, moderately shining, very finely and densely punctate, the interspaces minutely reticulate-granulate; each side with two groups of rather high, slender asperities, with anterior group near transverse impression usually two in number, the posterior group usually four in number and nearly midway between anterior and posterior margins; surface clothed with small recumbent scales, light cinereous except for a small area of fulvous scales at each side involving both groups of asperities; anterior margin with a sparse fringe of fulvous setae, shorter than in most species of *Renocis*.

Elytra 1.2 times as long as wide, slightly wider than pronotum; sides straight and subparallel on anterior two-thirds, very broadly rounded behind with combined apices appearing broadly emarginate in median area; basal margins strongly elevated from first to fifth interspace, gradually becoming lower laterally, with six or seven crenulations on each side; first stria impressed, the others not at all or very feebly impressed, punctures rather coarse, wider than long and very closely placed as seen in denuded specimens; interspaces nearly flat, finely rugose-punctate, each with a sparse median row of slightly larger punctures, sometimes accompanied by feeble granules, surface almost completely concealed by numerous small, semi-recumbent, cinereous scales, which mask even the striae, each interspace with a median row of short, stout, erect, fulvous setae, longer on the declivity; each elytron with a dense group of erect, brown setae just behind the basal elevation. Declivity steep, very broadly sulcate in the sutural area between the third interspaces of the elytra; third interspace elevated, with a few feeble granules, the median row of setae nearly lacking on interspaces 1 and 2 and replaced by a double row of longer, coarser setae on third interspace, causing the

sulcus to appear deeper than it actually is. Ventral surface reddish brown, shining, rather sparsely clothed with nearly white, recumbent, bifurcate scales, those on the last three abdominal segments being suberect and some of them entire. Foretibia (fig. 18, *c*) each with six rather large teeth on outer margin.

Male.—Similar in size and habitus, but with the frons concave for entire width, thinly clothed with hairs, with abundant, coarser, longer, fulvous hairs at sides; pronotum with posterior group of asperities poorly developed; venter of last abdominal segment with hairs directed laterally.

This species is rather closely related to *Pseudocryphalus maclayi* Bruck but differs in the absence of the frontal tubercles, in the notably stouter form, in the uniformly light-brown body color, and in the very different color pattern formed by the scales.

Type locality.—Southern California.

Additional locality.—Catalina Springs, Ariz.

Host.—*Encelia farinosa* A. Gray.

Type material.—Holotype, allotype, and 12 paratypes, U.S.N.M. No. 52950.

Remarks.—Holotype, allotype, and 7 paratypes are from the Coquillett collection, taken in San Bernardino County, Calif.; 1 paratype, labeled "Cal."; 1 specimen without data; 3 paratypes—"Catalina Springs, Ariz., Coll. Hubbard and Schwarz, on *Encelia farinosa*."

RENOCIS FASCIATUS, new species

FIGURES 17, *e*, *f*; 18, *d*

Female.—Piceous black, clothed with cinnamon-brown and light-cinereous scales; 1.45 to 1.8 mm. long; holotype 1.57 mm. long, 1.75 times as long as wide.

Frons with epistomal margin ending in a sharp median point, with a fringe of moderately long, rather fine, yellowish hairs, shorter and sparser at middle, reaching nearly to tips of mandibles at sides; arcuately, transversely impressed above epistoma, with impression widened and forming a subtriangular concavity extending to just above eyes; surface piceous, shining, finely and closely granulate-punctate, elevated and more strongly granulate at sides and above; surface of concavity partly concealed by rather short, moderately coarse, cinereous setae, which are longer and more abundant above and at sides. Eye about 3.3 times as long as wide, finely granulate, inner line shallowly, broadly emarginate. Antenna (fig. 17, *f*) with club comprising nearly half of visible length, slightly more than twice as long as wide, with three straight, annulate-setigerous sutures, setae rather long and slender.

Pronotum 1.6 times as wide as long, widest one-fourth of distance from base, which is broadly, strongly procurved, sides strongly arcuate, greatly narrowed anteriorly; a weak transverse impression just behind front margin, which is very broadly rounded, not sinuate in middle; surface piceous, shining, finely and densely granulate-punctate; at each side with two small groups (usually 2-4) of minute, sharp, inconspicuous asperities, those of anterior group (usually 2) slightly larger, one-fourth of distance from anterior margin to base; surface partially concealed by numerous small recumbent scales, some of them cinnamon-brown, some cinereous, the latter forming a wide border at each side of disk, a narrow transverse band on posterior margin, and a median stripe, broad at posterior and anterior margins, and interrupted, or nearly so, midway; with cinnamon-brown scales elsewhere, extending to anterior margin; anterior margin with a dense fringe of longer, coarse, erect setae, shorter and nearly lacking in middle.

Elytra 1.17 times as long as wide, wider than pronotum; sides straight and subparallel on anterior two-thirds, very broadly rounded behind, the apex broad and subtruncate; basal margins strongly elevated near suture, gradually becoming lower from suture to fifth interspace at each side; with distinct black crenulations, those near suture arranged in an approximate quarter circle, the lateral ones opposite the third and fourth interspaces, at each side and progressively lower; striae rather narrow, first two deeper, but all distinctly impressed, punctures moderately fine and close; interspaces convex but appearing flat in unabraded specimens, rugose, very finely punctured, with a few feebly developed granules on the disk; surface masked by small recumbent scales, part of them cinnamon-brown and others very light cinereous, the latter forming in the type specimen a broad stripe in the sixth and seventh interspaces, a broad transverse band just back of the middle, and a stripe involving most of the sutural interspaces from the fascia to the apex; each interspace with a median row of short, suberect, brown, inconspicuous setae, which are slightly longer on the declivity; each elytron with a dense group of coarse, testaceous setae just posterior to the basal crenulations. Declivity steep, broadly, shallowly impressed, subsulcate in the sutural region, with a few small, blunt granules in the third interspace above.

Ventral surface sparsely clothed with nearly white, usually bifurcate scales anterior to third abdominal segment, those on third and fourth segments mostly light brown, erect, and more numerous, many bifurcate; fifth segment finely and closely punctured, pubescence brown, erect. Foretibia (fig. 18, *d*) with 8 teeth on the outer margin.

Male.—Similar in size and habitus to female; with antennal club (fig. 17, *e*) larger and more slender, more than 2.5 times as long as

wide; frontal hairs longer and frontal concavity apparently deeper; last abdominal segment with setae parted in median line.

This species ranges in size from 1.45 to 1.8 mm. long and differs considerably in color pattern owing to differences in the abundance and arrangement of the light scales. In a few specimens the elytral fascia is reduced and nearly absent, while in others it is broad and conspicuous.

Type locality.—Tucson, Ariz.

Other localities.—Arizona and Benson, Ariz.

Hosts.—Greasewood [*Covillea gentinosa* (Engelmann) Rydberg], mesquite (*Prosopis* sp.).

Type material.—Holotype, allotype, and 39 paratypes, U.S.N.M. No. 52951.

Remarks.—Holotype, allotype, and 30 paratypes are from greasewood, Tucson, Ariz.; 6 paratypes from cut twigs of mesquite, Benson, Ariz., Mr. Chissman, Coll.; 3 paratypes from "twigs of mesquite, Arizona, collection Wickham."

RENOCIS HETERODOXUS Casey

FIGURES 17, *a, g, h*; 18, *e*

Renocis heterodoxus CASEY, California Acad. Sci. Bull. 6, pp. 257-259, 1896.—SWAINE, New York State Mus. Bull. 134, p. 144, 1909.—BRUCK, Bull. Southern California Acad. Sci., vol. 35, pt. 2, pp. 119-120, 1936.

Type, a male.—Piceous-black, densely clothed with small scales, some dark brown and others cinereous in color, with brown or ashen, erect, spatulate setae; 1.8 mm. long, almost exactly twice as long as wide.

Frons with epistomal margin bearing a fringe of coarse, cinereous, downwardly directed setae, with a short, sharp tooth in middle; transversely impressed just behind the epistoma and broadly longitudinally impressed in median area to a point above the eyes, forming a rather shallow, subtriangular concavity; sides slightly elevated; surface shining, finely, rather sparsely punctured in median concavity, more coarsely, densely, and roughly punctate-granulate at the sides and above, often with a large granule or tooth at each side at level of upper angles of eyes; clothed with moderately long, light-brown setae, scanty below, abundant, longer, and shaggy at sides and above, concealing the surface. Eye nearly 3.5 times as long as wide, finely granulate, with inner line sinuate. Antenna (fig. 17, *h*) brown, funicle 5-jointed, longer than scape; club 2.26 times as long as wide, about as long as funicle and exposed part of scape together, with three nearly straight sutures marked by annuli and rows of setae, not septate.

Pronotum 1.52 times as wide as long, widest near base, which is nearly straight, feebly procurved; sides strongly arcuate behind,

strongly constricted in front of middle, with a transverse impression just behind the anterior margin, which is broadly rounded, slightly sinuate in median line; disk finely and densely punctate-granulate; with two small groups (2-4) of small, slender asperities at each side, one group just behind transverse impression, and behind this another group (usually only 2) of smaller ones; entire surface densely clothed with small recumbent scales, those at sides and on posterior third of disk light cinereous with a few brown ones intermixed, those on anterior median disk brown; a dense fringe of erect, brown scales (or short (spatulate setae) on the anterior margin.

Elytra 1.29 times as long as wide, very slightly wider than pronotum; sides straight and subparallel on basal two-thirds, semi-circularly rounded behind; basal margins very strongly elevated in scutellar region, becoming lower laterally and lacking lateral to fifth interspace, with 5 coarse, high serrations each side of suture; first and second striae moderately, the others more weakly impressed, punctures small, separated by less than their own diameters; interspaces feebly convex, rugose, very finely punctured, each with a median row of slightly coarser punctures, often accompanied by small granules, surface masked by numerous small recumbent scales, most of them brown, but nearly all those in first interspace and a few in other interspaces light cinereous, nearly white; with a single median row of erect, spatulate setae, usually brown, in each interspace; each elytron with a dense group of erect, brown setae just behind the crenate anterior margin. Declivity moderately sloping, with first and second interspaces broad and nearly flat, slightly depressed below level of third interspaces, which bears a few feeble granules.

Ventral surface piceous-brown, sparsely clothed with divided scales, which are cinereous except on last three abdominal segments, where they are light brown, longer, erect, and for the most part entire, but some bifurcate. Foretibia narrow at base, dilated distally, with eight moderately slender teeth on outer margin.

Female.—Similar to male but with frontal concavity shallower, frontal hairs shorter, antennal club slightly broader (fig. 17, *g*); pronotal asperities more strongly developed; pubescence on last abdominal sternite erect, not modified in median line.

Remarks.—The foregoing description of the male was prepared almost entirely from the type, which was collected near Reno, Nev. For a number of details, however, recourse was had to other specimens because of the obscuring of certain structures of the type by dirt. All measurements were made from the type except those of the antennae. For these dissections of other specimens mounted in balsam were used, it being impossible to make accurate measurements of such small structures on entire specimens.

Both the males and females show some degree of variation. The size ranges from 1.5 to 2.4 mm. long. The color pattern varies considerably, being dependent upon differently colored scales and setae against the background of the actual body color and upon the relative abundance and arrangement of the differently colored scales. As is usually true in various species of *Renocis*, the pronotal asperities or teeth are better developed in the female than in the male, but in each sex there is considerable variation. The type, a male, shows little indication of frontal tubercles, although the frontal hairs are partly abraded and if present the tubercles would be plainly seen. This seems to be true of most of the specimens of both sexes, although a few of each sex do show more or less feebly developed tubercles or large granules. Usually, however, these structures, unless exceptionally large, are well concealed by the frontal hairs.

Type locality.—Reno, Nev.

Type.—Casey collection, U.S.N.M. No. 37439.

Specimens studied by the writer include the type from Reno, Nev., specimens from Blacksmith Fork Canyon, Logan Canyon, Park City, and Dixie National Forest, Utah; Bray, Calif.; and Neil Creek and Ashland, Oreg. The recorded hosts are *Amelanchier florida* Lindley, *Cercocarpus betuloides* Nuttall, *C. alnifolius* Rydberg, *C. ledifolius* Nuttall, and *Prunus virginiana melanocarpa* (A. Nelson) Sargent.

RENOCIS BRUNNEUS, new specie

FIGURES 17, *i*; 18, *f*

Female.—Light reddish brown, clothed with cinnamon-brown and with light-cinereous scales; 1.7 to 2.17 mm. long.; holotype 2.1 mm. long, 1.96 times as long as wide.

Frons with epistomal margin bearing a sharp point in median line, with a fringe of moderately coarse, yellowish setae covering two-thirds of the mandibles; arcuately, transversely impressed above the epistoma, the impression somewhat widened in median area to upper angle of eyes (not extending dorsally as far as in most species); surface reddish brown, shining, the concavity finely punctate, the sides and dorsum densely, finely granulate-punctate; with a feeble elevation (tubercle) at each side at level of upper angle of eye; surface of concavity partly concealed by moderately short, coarse, light-brown setae, that of the lateral and dorsal elevations almost entirely concealed by more numerous longer ones. Eye approximately 3 times as long as wide, finely granulate, the inner line broadly, shallowly sinuate. Antenna with club (fig. 17, *i*) 2.25 times as long as wide, as long as the remaining visible part of antenna, with three sutures marked by annuli and rows of setae.

Pronotum 1.6 times as wide as long, widest near base, which is broadly procurved medially; sides strongly arcuate on posterior two-thirds, then constricted and distinctly transversely impressed just behind the very broadly rounded front margin, which is sinuate (broadly and shallowly emarginate) in middle; surface shining, reddish brown, finely and closely granulate-punctate; at each side with two small groups of rather small asperities, about one-fourth and one-half of the distance from anterior margin, each group usually with three or four asperities, united in transverse line; with a few very low, weak asperities anteriorly in transverse impression; surface partly masked by numerous small, recumbent scales, those at sides and on posterior third consisting of many nearly white, cinereous ones with a few cinnamon-brown ones intermixed, those on rest of disk mostly cinnamon-brown; anterior margin with a sparse border of moderately long, coarse, brown, erect setae, shorter in middle.

Elytra 1.3 times as long as wide, slightly wider than pronotum; sides straight and subparallel on anterior two-thirds, broadly rounded behind; basal margins strongly elevated in median area, gradually becoming lower to fifth interspace on each elytron, with about 6 crenulations in a continuous line at each side; striae narrow, distinctly impressed, the first two deeper, punctures moderately small and close; interspaces convex, finely rugose-punctate, with a sparse median row of slightly larger punctures and a few feeble granules; surface rather sparsely clothed with small, recumbent scales, some of them a cinnamon-brown and some very light cinereous, the latter less numerous, intermixed with the darker scales in no definite pattern except for a narrow stripe in the sutural interspaces; each interspace with a median row of stout, erect, brown setae; each elytron with a dense group of brown setae just behind the basal margin. Declivity moderately steep, broadly, shallowly impressed in the sutural region, with a few fine low granules in the second and third interspaces, visible only in denuded specimens.

Ventral surface reddish brown, shining, sparsely clothed with nearly white, recumbent, usually bifurcate scales except on the last three abdominal segments, those on last three segments mostly brown, mostly entire, erect. Foretibia (fig. 18, *f*) with 10 teeth on outer margin.

Male.—Similar in size and habitus to female; antennal club more slender; frons similar to female except that the lateral hairs are longer and more abundant, and the frontal concavity is deeper; last abdominal segment with setae parted in median line.

This species shows about the usual variation in size; the pronotal asperities vary in development; the greatest differences are in the relative abundance and distribution of the light and dark scales.

Type locality.—Cloudcroft, N. Mex.

Host.—Unidentified shrub.

Type material.—Holotype, allotype, and 17 paratypes, U.S.N.M. No. 52952.

Remarks.—Holotype, allotype, and 17 paratypes under Hopkins U. S. Nos. 3977 and 3988, collected from and bred from an "unknown shrub" at Cloudcroft, N. Mex., by W. F. Fiske.

RENOCIS FUSCUS, new species

FIGURES 17, *j*; 18, *g*

Female.—Piceous-brown, clothed with scales varying from cinereous to fuscous; 1.88 mm. long, 1.9 times as long as wide.

Frons with sharp median point on epistomal margin, with a dense fringe of yellowish-cinereous setae; transversely impressed above the epistoma, with impression widened dorsally to form a concavity; sides and vertex convex; surface black, shining, finely and densely punctate, with fine granules at sides and above; surface partly concealed by coarse, rather long, light-brown setae, more abundant and longer at the sides and above. Eye more than 3 times as long as wide, finely granulate; inner margin feebly sinuate. Antenna with club (fig. 17, *j*) subacuminate at tip; 2.5 times as long as wide; with 3 straight, annulate-setigerous sutures.

Pronotum 1.6 times as wide as long, widest one-third of distance from base, which is feebly procurved; sides strongly arcuate behind, strongly constricted before middle; front margin broadly rounded, sinuate in middle; with a sparse fringe of erect, spatulate, fulvous setae, shorter in middle, with a transverse impression just back of anterior margin; surface piceous, shining, rather closely, finely punctate, finely granulate; at each side two groups (2 or 3 in each) of very small asperities; surface nearly concealed by numerous, small, recumbent scales, arranged as a broad band at the base and at sides, made up largely of broad and narrow cinereous scales intermixed, and on anterior two-thirds of disk small, broad, fulvous scales.

Elytra 1.25 times as long as wide, wider than pronotum; sides straight and subparallel on anterior two-thirds, broadly rounded behind; basal margin strongly elevated from suture to sixth interspace, with six or seven crenulations at each side, forming a continuous line; striae moderately narrow, distinctly impressed, punctures fine and close; interspaces broad, flat, surface shining, finely punctate, with a median row of slightly coarser punctures, rather sparsely clothed with numerous small, rather slender, recumbent, fuscous scales; in the median line of each interspace a row of erect spatulate setae, appearing cinereous in certain lights and fuscous brown in other lights; each elytron with a group of coarse, erect, fuscous setae

just behind the anterior crenulate margin. Declivity evenly arched, not sulcate, but with first and second striae more deeply impressed, the interspaces weakly convex.

Ventral surface dark reddish brown, shining, sparsely clothed with nearly white, bifurcate, recumbent scales, except on the last three abdominal segments, which have erect, fulvous setae. Foretibia (fig. 18, *g*) with eight rather long, slender teeth on outer margin.

Type locality.—Williams, Ariz.

Host.—*Cowania mexicana* D. Don.

Type material.—Holotype and one paratype, U.S.N.M. No. 52953.

Remarks.—Holotype and one paratype taken from *Cowania mexicana* at Williams, Ariz., by Schwarz and Barber. These two specimens were associated with numerous specimens of *Renocis commixtus*, new species.

RENOCIS COMMIXTUS, new species

FIGURES 17, *k*, *l*; 18, *h*, *i*

Female.—Brown to piceous, clothed with intermixed brown and ashy-white scales and setae; 1.6 to 2.2 mm. long; holotype 2.0 mm. long, almost exactly twice as long as wide.

Frons with a short sharp point in median line of epistomal margin, with a dense fringe of rather long, coarse, yellowish hair; transversely impressed above the epistoma, with this impression much widened in the median area forming an approximately triangular concavity, with the sides elevated and granulate-punctate; surface shining, concavity finely, not closely punctured, scantily covered by coarse, moderately long, fulvous hairs, which are much more abundant and conceal the surface at the sides and above. Eye finely granulate, 3.3 times as long as wide, the anterior margin distinctly sinuate. Antenna (fig. 17, *l*) with the club 2.4 times as long as wide, as long as funiculus and visible part of scape together, with three nearly straight setigerous-annulate sutures.

Pronotum 1.5 times as wide as long, widest near the base, which is procurved; the sides strongly arcuate on the posterior two-thirds, strongly constricted in front of middle, with a moderate transverse impression behind anterior margin, which is broadly rounded, very feebly or not at all sinuate in middle; surface shining, finely and densely granulate-punctate, with three small groups of small sharp asperities on each side, one group just behind anterior margin, one behind the transverse impression, and a third group two-fifths of distance between second group and posterior pronotal border, surface clothed with small recumbent scales, those on the anterior part of disk brown, those on sides and on posterior part of disk a variable mixture of brown and nearly white scales; anterior pronotal margin

with a dense fringe of longer, erect, brown, spatulate setae, shorter in the median line and much longer at each side.

Elytra 1.4 times as long as wide, slightly wider than pronotum; sides straight and subparallel on basal two-thirds, moderately broadly rounded behind (more narrowly than in *heterodoxus*); basal margins strongly elevated in scutellar region, gradually becoming lower from suture to fifth interspace on each elytron, usually with 6 rounded serrations at each side, in a continuous line; striae narrow, impressed, the first more strongly than the others, punctures small and close; interspaces feebly convex, rugose, very finely punctured, each with a median row of larger punctures often accompanying small blunt granules; surface masked by small recumbent scales (not so numerous as in *heterodoxus*), most of these in type, brown except for a light-colored median stripe in sutural interspaces, while the third, fifth, and seventh interspaces contain many light-cinereous scales in their anterior thirds (some specimens have throughout a "pepper-and-salt" mixture of dark and light scales); each interspace with a median row of erect, rather short, coarse setae, most of them brown but a few pale; each elytron with a dense group of coarse, dark-brown setae just behind the elevated anterior margin. Declivity steeper than in *heterodoxus*, the first striae impressed but first and second interspaces normal, feebly convex.

Ventral pubescence light cinerous except on last 3 abdominal segments, most of scales bifurcate or trifurcate; 3 posterior abdominal segments with entire, coarse, brown, suberect setae; last segment with erect setae, with posterior margin but little narrower in middle. Foretibia (fig. 18, *h, i*) with 9-11 teeth on outer margin.

Male.—Similar in habitus to female, with the antennal club (fig. 17, *k*) slightly longer and more slender; frons more strongly concave; pronotal asperities more feebly developed; last abdominal sternite with posterior rim very feebly emarginate and the setae parted in the median line.

This species shows a considerable range of variation in size (1.6 to 2.2 mm. long), in arrangement of the light and dark scales and setae, and in sculpture, the pronotal asperities especially varying both in number and in coarseness.

Type locality.—Williams, Ariz.

Additional localities.—Colorado Springs and North Cheyenne Canyon, Colo.

Host.—*Cowania mexicana* D. Don.

Additional hosts.—*Prunus americana* Marshall, apple, wild currant.

Type material.—Holotype, allotype, and 162 paratypes, U.S.N.M. No. 52954.

Remarks.—Holotype, allotype, and 146 paratypes were collected and bred from twigs of *Cowania mexicana* at Williams, Ariz., by Barber and Schwartz. Sixteen paratypes are from Colorado Springs and Cheyenne Canyon, Colo., bred from *Prunus americana* or collected on wild currant and apple by B. T. Harvey.

RENOCIS BRITTAINI (Swaine), new combination

Pseudocryphalus brittaini SWAINE, Canada Dept. Agr., Ent. Branch, Bull. 14, pt. 1, p. 20, 1917; pt. 2, p. 57, 1918.—BEUCK, Bull. Southern California Acad. Sci., vol. 35, pt. 1, p. 35; pt. 2, p. 121, 1936. (Genotype of *Pseudocryphalus* Swaine.)

"Length, 1.9 mm.; stout, black, with brown and gray scales; the front plano-concave, with a strong transversely arcuate impression behind the epistoma, the middle line impressed, clothed with stout pubescence, becoming long, dense and pale on the epistomal margin, with a rather coarse granule behind the impression on each side the middle line; the eyes long, narrow, extending upon the ventral surface.

"The pronotum twice as wide as long; the sides very strongly rounded behind and very strongly constricted in front; the front margin broadly emarginate at the middle; very densely subgranulately punctured, clothed with brown and grey, very stout pubescence, the grey predominating on the sides and behind; the cephalic margin unarmed or nearly so, somewhat elevated, with pale fine pubescence and brown, elongate, elevated scales; with three pairs of elongate recurved rugosities in a longitudinal row on the middle of each side in front, the first pair on the front margin.

"The elytra as wide as the pronotum, slightly less than one-half longer than wide, the basal margin very strongly elevated, recurved and coarsely serrate in the scutellar region; the sides subparallel on the basal half, broadly rounded behind; the striae distinctly, rather strongly impressed, the stria punctures rather coarse, not close, deep and distinct, bearing very minute setae; the interspaces feebly convex, minutely punctured, and with a median row of granules, bearing very small, elongate scales which hardly cover the surface, and a median row of longer, erect, very stout bristles; the pubescence brown, with numerous scattered white scales, more abundant toward the base and forming a narrow band along the suture; the first two abdominal sternites subequal in length, each longer than the next two united.

"Salmon Arm, B. C.; apple trees, in dying bark."

The above is Swaine's original description quoted verbatim. No specimen of the species has been seen by the writer.

Types in Canadian National Collection, Ottawa, Canada.

***RENOCIS CRIDDLEI* (Swaine), new combination**

Pseudocryphalus criddlei SWAINE, Canada Dept. Agr., Ent. Branch, Bull. 14, pt. 1, p. 21, 1917; pt. 2, p. 58, 1918.

"This species is very closely allied to *brittaini*; with the same size, form, and colour; but it is apparently distinct through the very feebly impressed elytral striae, and the small, very closely placed stria punctures.

"Series of 108 specimens from Aweme, Man., *Prunus virginiana*; collected by Mr. Norman Criddle."

Swaine's original description is quoted verbatim. The writer has seen no specimen of this species.

Type and paratypes are in the Canadian National Collection, Ottawa, Canada.

***RENOCIS PENICILLATUS* Bruck**

FIGURES 17, *m*; 18, *f*

Renocis penicillatus BRUCK, Can. Ent., vol. 65, p. 239, 1933; Bull. Southern California Acad. Sci., vol. 35, pt. 2, p. 120, 1936.

Female.—Piceous with cinereous scales and hairs; with two pencils of long setae just behind front margin of pronotum; 1.14 to 1.6 mm. long, about 1.8 times as long as wide.

Frons with a median point on epistomal margin; with a fringe of nearly white setae covering basal halves of mandibles; nearly flat, feebly impressed just above epistoma and in median line; surface piceous, shining, finely and closely punctate-granulate; clothed with coarse, moderately long, testaceous setae, slightly longer at sides and above. Eye slightly more than 3 times as long as wide, finely granulate, inner margin sinuate. Antenna (fig. 17, *m*) with club not much longer than funicle, slightly more than twice as long as wide, with distal end subacute, with three nearly straight annulate-setigerous sutures.

Pronotum 1.57 times as wide as long, widest near base, which is very broadly, rather deeply emarginate in median half; sides strongly arcuate posteriorly, strongly narrowed in anterior half; transversely impressed just behind anterior margin, which is broadly rounded, sinuate in median area; surface piceous, shining, very finely granulate-punctate, with less numerous, coarser, but still fine punctures interspersed; at each side with three groups of high, rather slender asperities or teeth, each group consisting of 2 or 3 teeth, posterior group just behind middle, second group just behind transverse impression, anterior group, smaller and occasionally lacking, on anterior margin; surface clothed with small cinereous scales, consisting of numerous narrow, recumbent ones, and less numerous (from coarser punctures), broad, suberect, cinereous scales; with a group of long cinereous hairs each side of median line, just behind anterior margin.

Elytra about 1.4 times as long as wide, slightly wider than pronotum, with sides straight and subparallel on anterior two-thirds, moderately broadly rounded behind, basal margin strongly elevated in scutellar region, including the fourth interspace at each side, with four or five serrations or crenulations on each elytral margin, not forming a continuous line; striae impressed, the first more deeply, nearly as wide as interspaces, punctures close and of moderate size; interspaces moderately convex, finely rugose punctate, each with a few feeble granules accompanying a median row of slightly coarser punctures, clothed with narrow recumbent scales, prevailing cinereous on the sutural interspaces and on the basal third, somewhat fulvous on the posterior disk and declivity; each interspace with a median row of erect, spatulate, fulvous setae; each elytron with a group of coarse, fulvous setae behind the crenulate anterior margins. Declivity rounded, unmodified, first striae impressed as on disk.

Ventral surface piceous-brown, shining, thinly clothed with nearly white, usually bifurcate, recumbent scales, which on the last three abdominal segments are more nearly erect and are mixed with fulvous setae. Foretibia (fig. 18, *j*) not so strongly widened distally as in most other species, with 6 long, slender teeth on outer margin.

Male.—Similar in size and habitus to female; with frons deeply concave and bordered on sides and above by numerous long setae; pronotum with posterior and anterior groups of asperities smaller than in female, sometimes lacking; with the tufts of hairs near anterior margin much longer, penicillate; setae on venter of last abdominal segment parted in median line.

Location of type material.—Holotype, allotype, and 25 paratypes in collection of C. R. Bruck. Paratypes: California Academy of Sciences, San Francisco; Canadian National Collection, Ottawa, Canada; collection of A. T. McClay.

Remarks.—This is a rather widely spread species and apparently is not confined to one host. *Renocis penicillatus* was described from material obtained from *Rhus integrifolia* and *R. ovata* in southern California. The writer has studied four specimens from Bruck's series, one obtained through the kindness of Dr. W. Dwight Pierce of the Los Angeles Museum and three specimens kindly lent by Prof. J. N. Knull from his own collection. These specimens are identical in all essential respects with more than 50 specimens in the National Museum from Arizona, Utah, and Colorado, collected by Hubbard and Schwarz, Hopkins, Webb, Wickham, and Harvey, and four specimens collected from *Rhus ovata* at Ensenada, Lower California, by F. P. Keen. Only in the last case is the host cited specifically, but in the Hopkins series from Flagstaff, Ariz., it is described as a "shrub resembling currant," probably *Ribes* sp.

RENOCIS MEXICANUS, new speciesFIGURES 17, *n*; 18, *k*

Female.—Black, clothed with piceous-brown scales forming a variegated color pattern with light cinereous, nearly white scales; 1.31 to 1.88 mm. long; holotype 1.72 mm. long, 2.0 times as long as wide.

Frons with a sharp median point on epistomal margin, and with a dense fringe of moderately fine, yellow-cinereous setae extending halfway to tips of mandibles; transversely impressed above epistoma, with center of frons flattened, feebly concave, sides and vertex convex; surface black, feebly shining, very finely and densely granulate-punctate; surface mostly concealed by coarse, rather short, fuscous setae, only slightly longer at sides and above. Eye finely granulate, about 3.3 times as long as wide, the inner line broadly and shallowly emarginate. Antenna (fig. 17, *n*) with club very large, longer than the scape and funicle combined, 2.19 times as long as wide, with three nearly straight sutures, both annuli and setae reduced in median line of outer face of club.

Pronotum 1.47 times as wide as long, widest near base, which is broadly procurved; sides strongly arcuate, nearly evenly narrowed anteriorly with front margin very broadly rounded, feebly sinuate in middle, with a very feeble, transverse impression just back of the margin; surface piceous, feebly shining, finely and densely granulate-punctate; at each side with two very inconspicuous groups of several slightly coarser granules (not sharp asperities as in other species of *Renocis*), almost entirely concealed except in abraded specimens; surface largely concealed by numerous scales, some of them narrow, recumbent ones and some wide and semierect, mostly piceous except for a transverse, basal band and a lateral border of light-cinereous scales; anterior margin with a sparse fringe of erect, dark brown, spatulate setae, interrupted in the middle.

Elytra 1.43 times as long as wide, slightly wider than pronotum; sides straight and subparallel on anterior two-thirds, rather narrowly rounded behind; basal margin strongly elevated from suture to opposite sixth interspace, with 8 distinct teeth in a continuous line on margin of each elytron, and with a second row of four coarse teeth, two at each side of suture, just behind margin; striae, except first, rather feebly impressed, punctures moderate in size, close; interspaces wider than striae, feebly convex, rugose, finely punctate, with a few small granules; surface partly concealed by small recumbent scales, most of them piceous, but with a narrow stripe of light-cinereous scales in anterior half of sutural interspaces and continued posteriorly as a single row of light scales next to suture, at each side an irregular spot of light scales in anterior half of fifth to seventh interspaces; in median line of each interspace a row of very broad,

flat, erect setae or scales, short on anterior disk, but becoming larger posteriorly; each elytron with a dense group of coarse, piceous-brown setae behind the anterior margin. Declivity evenly arched, not sulcate; first striae more strongly impressed, as on disk; punctures finer.

Ventral surface shining, piceous; clothed with nearly white, usually bifurcate, recumbent scales anterior to third abdominal segment, last three segments with erect, fuscous scales except at the sides of the third. Foretibia (fig. 18, *k*) with eight occasionally nine) rather short, stout teeth on outer margin.

Male.—Similar in size and habitus to female, but with the frons strongly concave and with longer hairs at sides and above; antennal club larger and more slender, 2.28 times as long as wide; last abdominal segment slightly shorter, with the setae parted in median line.

In this species the chief variations are in the size and in the color pattern formed by the light and the dark-colored scales.

Type locality.—Guadalajara, Jalisco, Mexico.

Other locality.—Mexico.

Host.—*Eysenhardtia* sp.

Type material.—Holotype, allotype, and 136 paratypes, U.S.N.M. No. 52955.

Remarks.—The type, allotype, and 11 paratypes are from Guadalajara, Mexico, intercepted at quarantine, Nogales, Ariz., in packing crates made of *Eysenhardtia* sp. (wood determined by Prof. S. J. Record); 48 paratypes from *Eysenhardtia* sp. (determined by W. N. Watkins), Mexico, September 11 and 24, 1936; 77 other paratypes were intercepted at quarantine from Mexico, but there are no data either as to host or locality of origin.

RENOCIS BRAZILIENSIS, new species

FIGURES 17, *o*; 18, *l*, *m*.

Female.—Reddish brown, clothed with light-cinereous, nearly white scales and setae; 1.31 to 1.63 mm. long; holotype 1.48 mm. long, 1.7 times as long as wide.

Frons with a very small median point on epistomal margin, with fringe of rather fine, yellow-cinereous setae extending halfway to tips of mandibles; arcuately, transversely impressed above epistoma, with center of frons flat, sides and vertex rounded; surface reddish brown, moderately shining, finely, densely granulate-punctate; surface partly concealed by rather short, stout, cinereous setae, only slightly longer at the sides and above. Eye about 3.5 times as long as wide, finely granulate, inner margin sinuate, subemarginate. Antenna (fig. 17, *o*) with club broad-oval, 1.58 times as long as wide, with three nearly straight, annulate-setigerous sutures, the funicle attached dorsad of its axis.

Pronotum 1.6 times as wide as long, widest near base, which is very broadly emarginate in median half; sides strongly arcuate behind, constricted anteriorly; front margin very broadly rounded, feebly sinuate in median area; with a weak transverse impression just behind margin, which bears a sparse fringe of erect, spatulate, cinereous setae, slightly shorter in median area; surface reddish brown, shining, finely punctate, reticulate-granulate; at each side with two groups of fine, sharp asperities (3 or 4 in each group), one group on anterior third, the other on posterior half of disk; surface rather sparsely clothed with numerous, small, recumbent, cinereous scales, varying from narrow to broad; with a few erect setae in median line near base.

Elytra 1.22 times as long as wide, very slightly wider than pronotum; sides straight and subparallel on anterior two-thirds, very broadly rounded behind; basal margin strongly elevated between the sixth interspaces, with a continuous, somewhat bisinuate line of teeth, 7 or 8 on each elytron, and with a smaller tooth just behind margin in each sutural interspace; striae distinctly impressed, about one-half as wide as interspaces, punctures close, moderate in size; interspaces weakly convex, finely rugose-punctate with a few feeble granules, punctures in median line of each interspace slightly larger; surface reddish brown, shining, partly concealed by rather numerous small, recumbent, yellowish-cinereous scales, most of them rather wide, but those on inner margin of each sutural interspace narrow and hairlike; each interspace with a median row of longer, erect, concolorous scales, or short, wide setae, becoming slightly longer behind. Declivity evenly arched, not sulcate, with interspaces slightly narrowed.

Ventral surface reddish brown, shining, clothed with yellowish-cinereous, recumbent scales, usually bifurcate; last abdominal segment with erect, yellowish-cinereous setae. Foretibia (fig. 18, *l*) with seven stout teeth on outer margin.

Male.—Similar in size and general habitus to female, but with the frons strongly concave for entire width, with much longer setae at sides and above; antennal club larger, about 1.8 times as long as wide; pronotum with setae on anterior margin longer, and with asperities greatly reduced or even lacking; teeth on foretibia usually nine in number (fig. 18, *m*).

Type locality.—Ceara, Brazil.

Host.—Unknown.

Type material.—Holotype, allotype, and 19 paratypes, U.S.N.M. No. 52956.

Received from D. da Rocha, Ceara, Brazil.

RENOCIS INSULARIS, new species

FIGURES 17, *p*; 18, *n*

Female.—Light reddish brown, with cinereous and fulvous scales; 1.46 mm. long, 1.82 times as long as wide.

Frons with epistomal margin scarcely toothed in median line, fringed with fine yellow-cinereous setae, covering basal halves of mandibles; very feebly transversely impressed above epistoma, frons convex, only slightly flattened on disk; surface subopaque, reddish brown, finely granulate-punctate; surface partly concealed by rather short, stout, recumbent, cinereous setae directed dorso-mesad. Eye 3 times as long as wide, finely granulate; the inner line broadly, shallowly emarginate. Antenna (fig. 17, *p*) with club broad-oval, 1.33 times as long as wide; with three annulate-setigerous sutures, first nearly straight, second and third rather weakly procurved.

Pronotum 1.61 times as wide as long, widest near base, which is very broadly, shallowly emarginate in median half; sides behind strongly arcuate, constricted anteriorly; scarcely at all impressed behind the broadly rounded front margin, which is very feebly sinuate in median area, and bearing a sparse fringe of erect, spatulate, fulvous setae, only slightly shorter in median area; surface reddish brown, feebly shining, finely punctate, reticulate-granulate; at each side with two transverse rows of small, sharp asperities (4-6 each row), each bordered posteriorly by a single row of erect, yellow-cinereous scales; surface partly concealed by numerous small, recumbent scales, fulvous on anterior disk and nearly white on sides and on a narrow band behind; with a few erect setae in median line near base.

Elytra 1.26 times as long as wide, scarcely wider than pronotum; sides straight and subparallel on anterior two-thirds, moderately broadly rounded behind; basal margins moderately strongly elevated from suture to fifth interspace on each elytron, with eight crenulations on each in a continuous line; striae impressed, less than half as wide as interspaces, punctures close, of moderate size; interspaces appearing nearly flat, finely rugose-punctate, with a few weak granules, median row of punctures slightly larger; surface reddish brown, shining, partly concealed by numerous scales, recumbent anteriorly on disk, suberect behind, with a median row of erect scales or short setae in each interspace; scales cinereous and fulvous intermixed, with a single row of nearly white cinereous scales next to suture in each sutural interspace. Declivity evenly arched, not sulcate, striae equally impressed, interspaces slightly narrowed and scales erect or suberect.

Ventral surface reddish brown, feebly shining, thinly clothed with nearly white, recumbent, usually bifurcate scales, with some of scales

replaced by erect, coarse setae on last three abdominal segments. Fore tibia (fig. 18, *n*) with outer margin armed with four short, very stout, blunt teeth.

Male.—Similar in size and habitus, but with the frons distinctly concave from eye to eye, with longer and more abundant setae at sides and above; pronotum with asperities nearly lacking.

Type locality.—Key West, Fla.

Additional locality.—Cayamas, Cuba.

Host.—Unknown.

Type material.—Type, allotype, and 2 paratypes, U.S.N.M. No. 52957.

Remarks.—Holotype, allotype, and 1 female paratype from Key West, Fla., collection of Hubbard and Schwarz; 1 female paratype. Cayamas, Cuba, E. A. Schwarz, collector.



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TWO NEW GENERA AND THREE NEW SPECIES OF
CHEILODIPTERID FISHES, WITH NOTES ON
THE OTHER GENERA OF THE FAMILY

By LEONARD P. SCHULTZ¹

IN studying the new forms of cheilodipterid fishes described in this paper some difficulty was experienced in deciding to which genera they should be referred. An examination of the literature and the cheilodipterid material in the National Museum suggested that the genera in this family were in great need of comparison. Therefore I have prepared a tentative key to the genera of the family Cheilodipteridae with the hope that other investigators will improve upon it as their available material is studied. As a result probably some of the genera I have placed in synonymy will be removed.

Certain ichthyologists have proposed new generic names in this group of fishes founded on characters that may not be of even specific significance, such as "a much larger, red, marine European species with considerably larger scales, longer maxillary, and differently formed head bones generally."² I refer here to such features as color spots, streaks, and lateral bands; number of soft rays in dorsal and anal fins; number of scale rows (especially in regard to the forms

¹ I wish to thank Dr. G. S. Myers, of Stanford University, for information concerning the type of *Galeagra pammelas*; Dr. F. P. Koumans, Rijksmuseum van Natuurlijke Historie, Lelden, for a description of the teeth of the type of *Pseudamia polystigma*; Dr. K. H. Barnard, South African Museum, for information on *Parahynnodus* and a sketch of the teeth of *Neoscombrops anneotens*; Dr. P. Chabanaud, Muséum National d'Histoire Naturelle, Paris, for sketches of the teeth of the types of *Cheilodipterus lineatus* and *C. quinquelineatus*; Dr. S. L. Hora, Indian Museum, Calcutta, for much needed data on the type of *Brephostoma carpenteri*. Through exchanges with J. R. Norman, of the British Museum, I have been able to examine paratypes of *Gymnapogon japonicus* and *Synagrops microlepis*.

² Whitley, Gilbert P., Occ. Pap. Mus. Zool. Univ. Michigan No. 405, pp. 1-4, pl. 1, 1939.

referred to *Apogon*); length of fin rays or presence of filamentous rays; emargination of caudal fin. Probably some of these characters are useful for generic diagnoses if used in conjunction with other features. The presence or absence of palatine teeth and the union of the first and second dorsal or the extent of the space between these fins appear to be highly variable, just as is the completeness or incompleteness of the lateral line. In my opinion these variable characters, among others, should not be relied upon as of generic significance until their constancy has been determined for each species in any natural group.

KEY TO THE GENERA OF CHEILODIPTERIDAE

1a. Vent closer to base of pelvics than origin of anal fin.

2a. Anal rays III, 7 or 8; spines in first dorsal VII to IX; a pair of enlarged symphyseal canines inside front edge or margin of premaxillaries; small canines along front margin of premaxillaries, followed by a wide band of villiform teeth posteriorly; sides of lower jaw with canines and with 1 or 2 pairs of enlarged canines near symphysis (fig. 19, *a*).

Acropoma Temminck and Schlegel, 1842

2b. Anal rays II, 8; dorsal rays VI, I, 8 or 9; no symphyseal canines in either jaw; small canines widely spaced on sides of upper and lower jaws; posterior half of upper jaw with a band of villiform teeth (fig. 19, *f*); no palatine teeth; vomer with teeth; peritoneum silvery; maxillary extending past rear margin of pupil----- *Desmoamia* Fowler and Bean, 1930

1b. Vent closer to origin of anal fin than base of pelvics.

3a. Anal spines II.

4a. No canines in jaws even at symphysis; if teeth are present they are villiform and in narrow to wide bands (fig. 19, *h, i*).

5a. A thick silvery gland with black upper surface on each side of base of tongue from which a broad silvery canal extends backward on each side of isthmus to breast, then expands over base of pectoral and covers lower portion of abdomen, thence runs backward above base of anal fin to near base of caudal fin rays; first dorsal VI or VII; anal II, scales cycloid; lateral line complete or incomplete.----- *Siphamia* Weber, 1909

5b. No silvery gland as above.

6a. Anal rays II, 9; teeth if present villiform in one or two irregular rows on jaws (fig. 19, *h*); operculum with 2 flat spines; preoperculum without double edge, the lower posterior angle much produced and rounded; scale rows crossing lateral line about 36 to 60; anus in front of origin of anal fin a distance equal to or greater than diameter of pupil.

Epigonus Rafinesque, 1810

6b. Anal rays II, 7 to 13; teeth villiform in wide band on premaxillary and a narrow to wide band on dentary (fig. 19, *i*); operculum with 2 flat spines; preoperculum with double edge, posterior one not produced but with contour similar to that of anterior edge; scale rows crossing lateral line fewer than 50; caudal fin emarginate or rounded; lateral line complete or incomplete; anus just in front of origin of anal fin or as far distant as diameter of pupil----- *Apogon* Lacépède, 1802

- 6c. Anal rays II, 13 to 17; teeth in lower jaw short, conical, hooked inward, and arranged in 1 irregular row posteriorly on dentary and in 2 such rows anteriorly, outer row smaller than inner; 1 or 2 irregular rows of short, conical teeth in anterior part of upper jaw, followed by a wide band of villiform teeth posteriorly; operculum with 2 very weak spines; preoperculum with double edge, the posterior edge strongly serrated at angle and ventrally; scale rows crossing lateral line about 23 to 28; anus just in front of origin of anal fin or as far distant as diameter of pupil.----- *Archamia* Gill, 1863
- 6d. Anal rays II, 8 or 9; teeth small, equal, and pointed, uniserial in jaws; operculum with 3 or 4 short spines dorsally at rear edge near flap; preoperculum with double edge, lower angle produced; spines in first dorsal VII or VIII; vent closer to origin of anal than base of pelvics.----- *Oxyodon* Brauer, 1906
- 4b. Canines present in jaws.
- 7a. Anal rays II, 25; dorsal V or VI, I, 15 to 19; scales about 70; a single series of canine teeth in lower jaw, some of which are enlarged posteriorly; 2 pairs of enlarged canines at symphysis just inside marginal row of teeth at front of upper jaw; sides of upper jaw with very small canines along margin, inside of which is a narrow band of villiform teeth (fig. 19, d); preoperculum without double edge; maxillary not reaching to under front of eye.----- *Dinolestes* Klunzinger, 1872
- 7b. Anal soft rays fewer than 20; teeth not as above; maxillary reaching to at least under front of eye.
- 8a. Lateral line complete and not interrupted.
- 9a. Spines in first dorsal VI; scales fewer than 35; vent closer to origin of anal than base of pelvics; preoperculum with double edge, posterior margin near lower angle not produced.
- 10a. Tip of lower jaw with a few enlarged canines.
- 11a. No band of villiform teeth in lower jaw; lower jaw with a single series of large conical teeth, a few of which are enlarged canines widely spaced on sides of jaw and between which are small conical teeth in an irregular row; a pair or two of enlarged canines occur at symphysis of lower jaw; canine teeth in upper jaw in a group each side of a small toothless space at symphysis, no villiform teeth at tip of upper jaw, but following the canines occurs a wide band posteriorly (fig. 20, a).
Cheilodipterus Lacépède, 1802
- 11b. Villiform teeth in lower jaw in a band along sides but none at symphysis; lower jaw with 3 or 4 enlarged canines along midsides between which are villiform teeth; tip of lower jaw with about 3 pairs of enlarged canines; canine teeth in upper jaw located each side of symphysis in 2 or 3 pairs, anterior to which is a pair of patches of villiform teeth with a toothless space between; sides of upper jaw with a band of villiform teeth (fig. 20, b).
Cheilodipterops, new genus

- 10b. No canines at tip of lower jaw, but 3 to 6 pairs of enlarged canines located along midsides, tip of lower jaw with villiform teeth, this band extending along dentary; tip of upper jaw with a pair of patches of villiform teeth at symphysis, between which is a small toothless space; at sides of tip of upper jaw are 2 or 3 pairs of enlarged canines followed posteriorly by a band of villiform teeth (fig. 20, c).

Jadamga, new genus

- 9b. Spines in first dorsal IX, seldom VIII.

12a. Symphyseal canines at front margin of upper and lower jaws, behind canines at tips of upper jaw occurs a wide band of villiform teeth; lower jaw with a marginal series of enlarged canines inside of which is a narrow band of villiform teeth; each side of tip of lower jaw is a concave area with villiform teeth only (fig. 19, e); scales about 25 to 40; anal II, 7; caudal emarginate; preopercle with double edge, the lower angle not produced; maxillary reaching to about under middle of eye----- Synagrops Günther, 1887

- 12b. No symphyseal canines in lower jaw; 1 or 2 pairs of symphyseal canines just posterior to the marginal series at front of upper jaw (fig. 19, c); large conical teeth, widely spaced in a single series on both jaws; no villiform teeth present; anal II, dorsal VIII; scales about 63.

Telescopias Jordan and Snyder, 1901

- 8b. Lateral line incomplete or interrupted.

13a. Scales small, cycloid, anal II, 8; dorsal VI-I, 8 or 9; caudal rounded; symphyseal canines on upper and lower jaws; a band of villiform teeth on upper jaw, narrow laterally; in lower jaw a band of villiform teeth in front, laterally very narrow, with 2 large canines, followed by 2 smaller ones, all widely spaced, followed by a row of enlarged teeth closer together.

Pseudamia Bleeker, 1865

- 13b. Body scaleless; anal II, 9 or 10; dorsal VI-I, 10 or 11; caudal a little rounded; no symphyseal canines; a very narrow band of villiform teeth laterally on upper jaw (fig. 20, e); no teeth at symphysis of upper jaw, but at each side of this small toothless area are 4 canine teeth followed by the villiform band; symphysis of lower jaw with a small patch of villiform teeth, then on each side are a few small conical teeth; followed by about 6 enlarged and curved canines, these followed by 9 or 10 small pointed teeth, all in a single row; sides of body with short vertical series of pores in addition to the short interrupted series of lateral-line pores.

Gymnapogon Regan, 1905

3b. Anal spines III.

14a. Canine teeth present.

- 15a. Canines in upper jaw widely spaced and arranged in a single marginal series inside of which, beginning near middle of jaw, is a narrow band of villiform teeth; also enlarged canines near symphysis, just inside the marginal canine teeth (fig. 19, b); lower jaw with a single marginal series of canine teeth; teeth on vomer and palatines; preopercle with double edge, not serrate; first dorsal VII to IX; anal III.

Scombrops Temminck and Schlegel, 1842

- 15b. Only a pair of canines at symphysis of upper jaw and a similar pair of canines in lower jaw, the latter with a lateral series of close-set canines and a narrow inner band of villiform teeth more prominent posteriorly (fig. 20, d); teeth on vomer and palatines; preopercle without double edge; dorsals with IX-I, 9 or X, 11; anal rays III, 7 or 8; scales about 47 to 50.

Neoscombrops Gilchrist, 1922

14b. No canine teeth present.

- 16a. Opercle, subopercle, and interopercle armed with long strong spines; the upper one on operculum bifid, the lower multifid; subopercular spine bifid at tip; both jaws armed with small conical teeth in a single row, which are a little larger and in 1 or 2 rows near the symphyses; the V-shaped vomer and palatines each with a single row of teeth; dorsal rays VIII-I, 8 to 10; anal III, 6 or 7; scales about 27 to 37; pectoral fin much longer than head----- *Howella Ogilby, 1899*

- 16b. Opercular spines simple; anal rays III, 7.

- 17a. Opercle with 2 spines, subopercle with 2 spines, and interopercle with 1 spine; scales about 32 or 33; dorsal rays VIII-I, 9; teeth very small in single series on jaws; preopercle with double edge, posterior margin serrated near angle---*Bathysphyraenops Parr, 1933*

- 17b. Subopercle and interopercle without short spines, although margins of these bones may be serrated; scales about 55 to 70; dorsal rays X, 10; teeth minute or villiform in a single row or a very narrow band on both jaws (fig. 19, g); preopercle with double edge, the posterior margin serrated.

Apogonops Ogilby, 1896

3c. Anal rays I, 9 or 10.

18a. No teeth on jaws, palatines, or vomer;
dorsal rays V-I, 10.

Brephostoma Alcock, 1889

18b. Small teeth on jaws, palatines, and vomer, those on lower jaw and on vomer in an irregular double series; on upper jaw and on palatines teeth in a single series; dorsal rays VI-I, 11.—*Brinkmannella* Parr, 1933

Genus ACROPOMA Temminck and Schlegel

FIGURE 19, a

*Acropoma** TEMMINCK and SCHLEGEL, Siebold's Fauna Japonica, Pisces, pl. 12, figs. 2, 3, pp. 31-32, 1842. (Atypic; type, *Acropoma japonicum* Günther fixed by Günther, Catalogue of the fishes of the British Museum, vol. 1, p. 250, 1859.)

Genus DESMOAMIA Fowler and Bean

FIGURE 19, f

*Desmoamia** FOWLER and BEAN, U. S. Nat. Mus. Bull. 100, vol. 10, p. 123, 1930. (Genotype, *Cheilodipterus zonatus** Smith and Radcliffe: U. S. N. M. No. 70253, type.)

The following species, represented by a holotype in the National Museum, is referred to the genus *Desmoamia*:

*Cheilodipterus nigrotaeniatus** SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 442, pl. 37, fig. 3, 1912. (U. S. N. M. No. 70252.)

Genus SIPHAMIA Weber

Siphamia WEBER, Notes Leyden Mus., vol. 31, note 4, p. 168, 1909. (Orthotype, *Siphamia tubifer* Weber.)

Adenapogon McCULLOCH, Rec. Australian Mus., vol. 13, No. 4, p. 132, pl. 21, fig. 2, 1921. (Genotype, *Apogon roseigaster* Ramsay and Ogilby.)

Scopelapogon WHITLEY, Rec. Australian Mus., vol. 19, p. 74, 1933. (Orthotype, *Adenapogon* (*Scopelapogon*) *woodi* McCulloch.)

Fodifoa WHITLEY, Mem. Queensland Mus., vol. 11, pt. 1, p. 26, 1936. (Genotype, *Foa fistulosa* Weber.)

The following species, represented by a type in the National Museum, is referred to the genus *Siphamia*:

*Amia versicolor** SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 257, fig. 3, 1911. (U.S.N.M. No. 68401.)

* All genera and types of species marked with an asterisk (*) are represented by material in the U. S. National Museum and have been examined by the author.

Genus EPIGONUS Rafinesque

FIGURE 19, h

- Epigonus* RAFINESQUE, Indice d'ittologia siciliana . . . , p. 64, 1810. (Orthotype, *Epigonus macrophthalmus* Rafinesque.)
- Pomatomus* (Risso) CUVIER and VALENCIENNES, Histoire naturelle des poissons, vol. 2, p. 171, 1828. (Type, *Pomatomus telescopium* Risso.)
- Telescopus* BLEEKER, Arch. Néerl. Sci. Nat., vol. 11, pt. 1, p. 261, 1876. (Orthotype, *Pomatomus telescopium* Risso.)
- Pomatomichthys* GIGLIOLI, Elenco . . . e catalogo . . . dei pesci italiani, p. 20, 1880. (Orthotype, *Pomatomichthys constanciae* Giglioli=*Pomatomus telescopium* Risso, a synonym of *Epigonus*.)
- Hynnodus** GILBERT, Bull. U. S. Fish Comm., vol. 23 (1903), pt. 2, p. 617, pl. 79, 1905. (Orthotype, *Hynnodus atherinoides** Gilbert: U.S.N.M. No. 51601, type.)⁴
- Xystramia** JORDAN, Copeia, No. 44, p. 46, 1917. (Orthotype, *Glossamia pandionis* (Goode and Bean)=*Apogon pandionis** Goode and Bean: U.S.N.M. No. 26628, type.)
- Scepterias* JORDAN and JORDAN, Mem. Carnegie Mus., vol. 10, No. 1, p. 44, pl. 2, 1922. (Type, *Scepterias fragilis* Jordan and Jordan.)⁴
- Parahynnodus* BARNARD, Ann. Mag. Nat. Hist., ser. 9, vol. 20, p. 69, July 1927. (Orthotype, *Parahynnodus robustus* Barnard, Ann. South African Mus., vol. 21, p. 525, pl. 22, fig. 4, Oct. 1927.)⁴

The following species, represented by a type in the National Museum, is referred to the genus *Epigonus*:

- Hynnodus megalops** SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 445, pl. 38, fig. 3, 1912. (U.S.N.M. No. 70255.)

Genus APOGON Lacépède

FIGURE 19, i

- Amia* GÜNTHER, Zoophylacii . . . , p. 80, 1763 (nonbinomial). (Type, *Amia moluccensis* Cuvier and Valenciennes.)
- Apogon* LACÉPÈDE, Histoire naturelle des poissons, vol. 3, p. 411, 1802. (Type, *Apogon ruber* Lacépède.)
- Ostorhinchus* LACÉPÈDE, Histoire naturelle des poissons, vol. 4, p. 23, 1802. (Type, *Ostorhinchus fleurieu* Lacépède.)
- Dipterodon* LACÉPÈDE, Histoire naturelle des poissons, vol. 4, p. 167, 1802. (Type, *Dipterodon hexacanthus* Lacépède, designated by Jordan and Evermann, Genera of fishes, vol. 1, p. 63, 1917.)
- Macrolepis* RAFINESQUE, Analyse de la nature . . . , p. 89, 1815. (Type, *Apogon ruber* Lacépède; proposed to replace *Apogon* Lacépède.)
- Apogonoides* BLEEKER, Journ. Indian Archipelago, vol. 3, p. 70, 1849. (Orthotype, *Apogonoides macassarensis* Bleeker.)
- Microichthys* RÜPPELL, Verzeichniss in dem Museum Senckenbergischen . . . Sammlungen: Pt. 4, Fische und deren Skelette, p. 1, 1852. (Orthotype, *Microichthys coccoi* Rüppell.)

⁴ Matsubara, Journ. Imp. Fish. Inst., vol. 31, No. 2, pp. 119-130, 1936, has reviewed the genera *Hynnodus*, *Parahynnodus*, and *Scepterias* and is of the opinion that they should be referred to *Epigonus*, in which opinion I concur.

- Apogonichthys* BLEEKER, Nat. Tijdschr. Nederl.-Indië, vol. 6, pp. 312, 321, 1854. (Type, *Apogonichthys perdis* Bleeker.)
- Amia* GRONOW, Catalogue of fish collected and described by Laurence Theodore Gronow, now in the British Museum (edited by Günther), p. 173, 1854. (Orthotype, *Amia percaeformis* Gronow.)
- Monoprion* POEY, Mem. Hist. Nat. Cuba, vol. 2, p. 123, 1860. (Orthotype, *Monoprion maculatus* Poey.)
- Lepidamia* GILL, Proc. Acad. Nat. Sci. Philadelphia, 1863, p. 81. (Orthotype, *Amia kalosoma* Bleeker.)
- Glossamia* GILL, Proc. Acad. Nat. Sci. Philadelphia, 1863, p. 82. (Orthotype, *Apogon aprion* Richardson.)
- Mionorus* KREFFT, Proc. Zool. Soc. London, 1867, p. 943. (Orthotype, *Mionorus lunatus* Krefft.)
- Pristapogon* KLUNZINGER, Verh. zool.-bot. Ges. Wien, 1870, p. 715. (Type, *Apogon fraenatus* Valenciennes.)
- Vincentia* CASTELNAU, Proc. Zool. Acclim. Soc. Victoria, vol. 1, p. 245, 1872. (Type, *Vincentia waterhousei* Castelnau.)
- Gulliveria* CASTELNAU, Proc. Linn. Soc. New South Wales, vol. 3, p. 45, 1878. (Logotype, *Gulliveria fusca* Castelnau=*Apogon aprion*, a synonym of *Glossamia*.)
- Monosira* POEY, Anal. Soc. Españ. Hist. Nat., Madrid, vol. 10, p. 326, 1881. (Type, *Monosira stahli* Poey.)
- Fowleria* JORDAN and EVERMANN, Bull. U. S. Fish Comm., vol. 22 (1902), p. 180, 1903. (Type, *Apogon auritus* Valenciennes.)
- Foa* * JORDAN and EVERMANN, in Jordan and Seale, Proc. U. S. Nat. Mus., vol. 28, p. 779, July 3, 1905. (Orthotype, *Foa fo* * Jordan and Seale: U. S. N. M. No. 51735, type.)
- Foa* * JORDAN and EVERMANN, Bull. U. S. Fish Comm., vol. 23 (1903), pt. 1, p. 210, fig., July 29, 1905. (Orthotype, *Fowleria brachygrammus* * Jenkins: U. S. N. M. No. 50699, type.)
- Astrapogon* FOWLER, Proc. Acad. Nat. Sci. Philadelphia, 1906, p. 527. (Type, *Apogonichthys stellatus* Cope.)
- Rhabdamia* WEBER, Notes Leyden Mus., vol. 31, p. 165, 1909. (Orthotype, *Rhabdamia clupcisformis* Weber.)
- Neamia** SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 441, 1912. (Type, *Neamia octospina** Smith and Radcliffe: U.S.N.M. No. 70251, type.)
- Nectamia* JORDAN, Copela, No. 44, p. 46, 1917. (Type, *Apogon fuscus* Quoy and Gaimard.)
- Zoramia* JORDAN, Copela, No. 44, p. 46, 1917. (Type, *Apogon graeffi* Günther.)
- Brephamia* JORDAN, in Jordan and Jordan, Mem. Carnegie Mus., vol. 10, No. 1, p. 43, 1922. (Type, *Amia parvula** Smith and Radcliffe.)
- Gronovitchthys* WHITLEY, Rec. Australian Mus., vol. 17, p. 302, footnote, 1929; Mem. Queensland Mus., vol. 10, pt. 1, p. 11, 1930. (Orthotype, *Amia percaeformis* Gray.)
- Sphaeramia* FOWLER and BEAN, U. S. Nat. Mus. Bull. 100, vol. 10, p. 29, 1930. (Genotype, *Apogon nematoptera* Bleeker.)
- Ioamia* FOWLER and BEAN, U. S. Nat. Mus. Bull. 100, vol. 10, p. 130, 1930. (Genotype, *Apogonichthys gracilis* Bleeker.)
- Lovamia* WHITLEY, Mem. Queensland Mus., vol. 10, pt. 1, p. 10, 1930. (Orthotype, *Mullus fasciatus* White.)
- Yarcia* WHITLEY, Mem. Queensland Mus., vol. 10, pt. 1, p. 12, 1930. (Orthotype, *Apogon hyalosoma* var. *torresiensis* Castelnau.)

- Pterapogon* KOUMANS, Zoöl. Meded. Rijksmus. Nat. Hist. Leiden, vol. 16, p. 78, fig. 2, 1933. (Orthotype, *Pterapogon kauderni* Koumans.)
*Kurandapogon** WHITLEY, Occ. Pap. Mus. Zool. Univ. Michigan, No. 405, pp. 1-4, pl. 1, 1939. (Genotype, *Kurandapogon blanchardi** Whitley.)

The following species, represented by types in the U. S. National Museum, have been examined by the author and are referred to the genus *Apogon*:

- Amia retrosella* GILL, Proc. Acad. Nat. Sci. Philadelphia, 1862, p. 251. (U.S.N.M. Nos. 2454, 2997, 4413.)
Apogon alutus JORDAN and GILBERT, Proc. U. S. Nat. Mus., vol. 5, p. 279, 1882. (U.S.N.M. No. 30874.)
Apogon atricaudus JORDAN and MCGREGOR, in Jordan and Evermann, U. S. Nat. Mus. Bull. 47, p. 2853, 1898. (U.S.N.M. No. 48527.)
Apogon scillicauda EVERMANN and MARSH, Bull. U. S. Fish Comm., vol. 20, pt. 1, p. 143, fig. 40, 1900. (U.S.N.M. No. 49529.)
Apogon unicolor DÖDERLEIN, in Jordan and Snyder, Proc. U. S. Nat. Mus., vol. 23, p. 749, pl. 33, 1901. (U.S.N.M. No. 49708.)
Apogonichthys waikiki JORDAN and EVERMANN, Bull. U. S. Fish Comm., vol. 22, p. 179, 1903. (U.S.N.M. No. 50639.)
Apogon snyderi JORDAN and EVERMANN, Bull. U. S. Fish Comm., vol. 22, p. 180, 1903. (U.S.N.M. No. 50640.)
Apogon mcneusem JENKINS, Bull. U. S. Fish Comm., vol. 22, p. 448, 1903. (U.S.N.M. No. 50700.)
Apogon erythrinus SNYDER, Bull. U. S. Fish Comm., vol. 22, p. 526, pl. 9, fig. 17, 1904. (U.S.N.M. No. 50876.)
Apogon evermanni JORDAN and SNYDER, Proc. U. S. Nat. Mus., vol. 28, p. 123, 1904. (U.S.N.M. No. 51487.)
Amia gilberti JORDAN and SEALE, Proc. U. S. Nat. Mus., vol. 28, p. 777, fig. 3, 1905. (U.S.N.M. No. 51941.)
Mionorus mydrus JORDAN and SEALE, Proc. U. S. Nat. Mus., vol. 28, p. 778, fig. 4, 1905. (U.S.N.M. No. 51946.)
Amia exostigma JORDAN and STARKS, in Jordan and Seale, Bull. U. S. Bur. Fish., vol. 25, p. 238, fig. 31, 1906. (U.S.N.M. No. 51732.)
Amia doryssa JORDAN and SEALE, Bull. U. S. Bur. Fish., vol. 25, p. 245, fig. 39, 1906. (U.S.N.M. No. 51812.)
Foa rainulac JORDAN and SEALE, Bull. U. S. Bur. Fish., vol. 25, p. 249, fig. 43, 1906. (U.S.N.M. No. 51734.)
Apogonichthys isostigma JORDAN and SEALE, Bull. U. S. Bur. Fish., vol. 25, p. 251, fig. 45, 1906. (U.S.N.M. No. 51736.)
Amia jenkinsi EVERMANN and SEALE, Bull. U. S. Bur. Fish., vol. 26, p. 73, fig. 9, 1907. (U.S.N.M. No. 55907.)
Apogonichthys mentalis EVERMANN and SEALE, Bull. U. S. Bur. Fish., vol. 26, p. 74, fig. 10, 1907. (U.S.N.M. No. 55905.)
Apogonichthys nofae SNYDER, Proc. U. S. Nat. Mus., vol. 36, p. 599, 1909. (U.S.N.M. No. 62947.)
Amia compressa SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 246, pls. 20, 21, 1911. (U.S.N.M. No. 68398.)
Amia angustata SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 253, fig. 1, 1911. (U.S.N.M. No. 68399.)
Amia robusta SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 254, fig. 2, 1911. (U.S.N.M. No. 68400.)
Amia diencaea SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 431, pl. 34, fig. 1, 1912. (U.S.N.M. No. 70243.)

- Amia parrula* SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 432, pl. 34, fig. 2, 1912. (U.S.N.M. No. 70244.)
- Amia hyalina* SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 433, pl. 36, fig. 2, 1912. (U.S.N.M. No. 70245.)
- Amia diversa* SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 434, pl. 37, fig. 1, 1912. (U.S.N.M. No. 70246.)
- Amia nigrocincta* SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 435, pl. 37, fig. 2, 1912. (U.S.N.M. No. 70247.)
- Amia unimotata* SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 436, pl. 34, fig. 3, 1912. (U.S.N.M. No. 70248.)
- Amia striata* SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 437, pl. 35, fig. 1, 1912. (U.S.N.M. No. 68403.)
- Amia albomarginata* SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 438, pl. 35, fig. 2, 1912. (U.S.N.M. No. 68402.)
- Amia atrogaster* SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 439, pl. 35, fig. 3, 1912. (U.S.N.M. No. 70249.)
- Amia guadalupensis* OSBURN and NICHOLS, Bull. Amer. Mus. Nat. Hist., vol. 37, art. 16, p. 160, fig. 9, 1916. (U.S.N.M. No. 87545.)
- Kurandapogon blanchardi* WHITLEY, Occ. Pap. Mus. Zool. Univ. Michigan, No. 405, pp. 1-4, pl. 1, 1939. (U.S.N.M. No. 100466.)

Genus ARCHAMIA Gill

Archamia GILL, Proc. Acad. Nat. Sci. Philadelphia, 1863, p. 81. (Orthotype, *Apogon bleekeri* Günther.)

The characters given in the key for this genus were based mostly on specimens of *Archamia lineolata* (Cuvier and Valenciennes), U.S.N.M. Nos. 52203 and 89255, from Apia.

Genus OXYODON Brauer

Oryodon BRAUER, Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer *Valdivia* 1898-99, vol. 15, p. 287, fig. 172, 1906. (Orthotype, *Oxyodon macrops* Brauer.)

Genus DINOlestes Klunzinger

FIGURE 19, d

- Dinolestes** KLUNZINGER, Arch. Naturg., vol. 38, pt. 1, p. 29, 1872. (Type, *Dinolestes muelleri* Klunzinger.)
- Lanioperca* GÜNTHER, Ann. Mag. Nat. Hist., ser. 4, vol. 10, p. 183, 1872. (Orthotype, *Lanioperca mordax* Günther=*Dinolestes muelleri* Klunzinger.)
- Neosphyraena* CASTELNAU, Proc. Zool. Acclim. Soc. Victoria, vol. 1, p. 96, 1872. (Orthotype, *Neosphyraena multiradiata* Castelnau.)

Genus CHEILODIPTERUS Lacépède

FIGURE 20, a

- Cheilodipterus** LACÉPÈDE, Histoire naturelle des poissons, vol. 3, p. 539, 1802. (Type, *Cheilodipterus lineatus* Lacépède, as restricted by Cuvier and Valenciennes.)
- Aspro* (Commerson) LACÉPÈDE, Histoire naturelle des poissons, vol. 4, p. 273, 1803. (Type, *Cheilodipterus macrodon* Lacépède, as restricted by Jordan.)

- Clodipterus* RAFINESQUE, *Analyse de la nature* . . ., pp. 86, 88, 1815. (Substitute for *Cheilodipterus* Lacépède.)
- Chilodipterus* GÜNTHER, *Catalogue of the fishes of the British Museum*, vol. 1, p. 248, 1859. (Type, *Cheilodipterus lineatus* Lacépède.)
- Paramia* BLEEKER, *Nederl. Tijdschr. Dierk.*, vol. 1, p. 233, 1863. (Type, *Cheilodipterus lineatus* Lacépède; proposed to replace *Cheilodipterus* Lacépède.)
- Acanthapogon** FOWLER, *Acad. Nat. Sci. Philadelphia Monogr.* 2, p. 197, pl. 8, fig. 18, 1938. (Genus based on tiny young; type, *Acanthapogon vanderbilti** Fowler: U.S.N.M. No. 107189, paratypes.)

The following species, represented by a holotype in the National Museum, is referred to the genus *Cheilodipterus*:

- Chilodipterus affinis** POEY, *Ann. Lyc. Nat. Hist. New York*, vol. 11, p. 58, 1876. (U.S.N.M. No. 37416.)

CHEILODIPTEROPS, new genus

FIGURE 20, b

Two or three pairs of canines at symphysis of lower jaw, each side of lower jaw with three or four enlarged canines; posterior to the symphyseal canines occur villiform teeth; each side of tip of upper jaw with a small patch of villiform teeth, followed by three pairs of canines, remainder of jaw with wide band of villiform teeth; vomer and palatines with small teeth, other characters are those of the new species.

Genotype.—*Cheilodipterops isostigma*, new species.

CHEILODIPTEROPS ISOSTIGMA,* new species

Holotype.—U.S.N.M. No. 30657. A specimen 74 mm. in standard length taken at New Guinea by the Linnean Society, Sydney, Australia, previous to 1882.

Description.—Body compressed, elongate, with large ctenoid scales; lateral line continuous but not extending on caudal fin rays; interorbital space slightly concave; maxillaries slipping under preorbital anteriorly, and a little posteriorly a small supplementary bone posteriorly on upper edge of maxillary; maxillary reaching to beyond a vertical line from rear edge of pupil; premaxillary protractile, its upper edge concealed by preorbital bones; mouth terminal, jaws equal, the lower fitting inside the canines of upper jaw; small symphyseal knob at tip of lower jaw; pelvic rays I, 5; dorsal VI–I, 9; anal II, 8, the first spine very small, about $\frac{1}{3}$ pupil; pectoral rays 11–11; principal caudal rays 17, scales $21\frac{1}{2} + 25 + 51\frac{1}{2}$; cheeks with large scales; gill rakers on first arch 5 + 15 and 5 + 16; preoperculum with double edge, the posterior edge finely serrated; pseudobranchiae present; operculum with one very weak flat spine that does not extend beyond the membranous bone; anus about the diameter of eye in

advance of origin of anal fin, much closer to origin of anal than insertion of pelvics, gill membranes extending far forward not joined to isthmus; branchiostegals 6; caudal fin slightly emarginate.

Measurements.—The measurements outside the parentheses are in millimeters, and those in the parentheses are expressed in hundredths of the standard length. Distance from tip of snout to base of midcaudal fin rays 74; greatest depth of body 19 (25.7); least depth of caudal peduncle 10 (13.5); length from base of last anal ray to base of midcaudal fin rays 21 (28.4); head 29 (39.2) diameter of eye 9 (12.2) snout 6.9 (9.3); bony interorbital space 3.7 (5.0); length of longest pectoral fin ray 14.7 (19.9); length of second (longest) anal spine 10.4 (14.1); length of longest dorsal spine or second spine 13 (17.5); tip of snout to origin of spiny dorsal fin 32.5 (44.0); tip of snout to origin of anal fin 50 (67.7); tip of snout to insertion of pectoral fin 29 (39.2); tip of snout to insertion of pelvic fins 29.6 (40.0); tip of snout to center of anus 42.7 (57.7); length of maxillaries 10.5 (14.2).

Color in alcohol.—Peritoneum silvery; sides of body with five narrow, longitudinal, brown streaks and a midventral one on breast between pelvics; on occiput begins the most dorsal streak, continuing along midline of back, dividing just in front of origin of dorsal, a branch passing along each side of base of rays, uniting just behind base of dorsal, and continuing along middorsal line of caudal peduncle; second one begins at tip of snout passing along top of head at dorsal edge of orbit, over posttemporal, and along lateral line, leaving it a little in front of origin of dorsal and continuing along upper side of caudal peduncle; the median streak begins on tip of snout, passes through eye and along midside of body, ending on caudal peduncle; the next one begins on tip of lower jaw and passes just below eye and along midventral side to caudal fin base; the ventral streak begins on tip of lower jaw, extending along ventral margin of

FIGURE 19.—Upper and lower jaws of cheilodipterid fishes, showing arrangement of the teeth; bands and patches of villiform teeth are blackened; white spots in black area represent canine teeth, usually in a single row along outer margin; vomerine and palatine teeth not shown: *a*, *Acropoma japonicum*, diagram based mostly on U.S.N.M. Nos. 49823, 49824, and 57756; *b*, *Scombrops*, based on U.S.N.M. Nos. 48138, 49932, 57524, and 59619 (specimens of *S. cheilodipterus* and *S. boops*); *c*, *Telescopias gilberti*, based on U.S.N.M. No. 57540, a paratype; *d*, *Dinolestes muelleri*, based on U.S.N.M. Nos. 49712 and 49713; *e*, *Synagrops*, based on U.S.N.M. Nos. 51434 (*S. japonica*), 39338 (type), 39346, 44621, 74325–74328 (all paratypes of *S. bella*), 70254 (type of *S. serratospinosa*), 70250 (type of *Amia grossidens*), and 47732 (type of *Melanostoma argyreum*); *f*, *Desmoamia zonatus*, based on U.S.N.M. No. 70253 (type) and 70252 (type of *Cheilodipterus nigrotaeniatus*); *g*, *Apogonops*, based on U.S.N.M. No. 74085 (type of *Parasphyraenops atrimanus*); *h*, *Epigonus*, based on U.S.N.M. Nos. 44827 and 49351 (specimens of *E. telescopius*); *i*, *Apogon*, based on numerous specimens of several species.

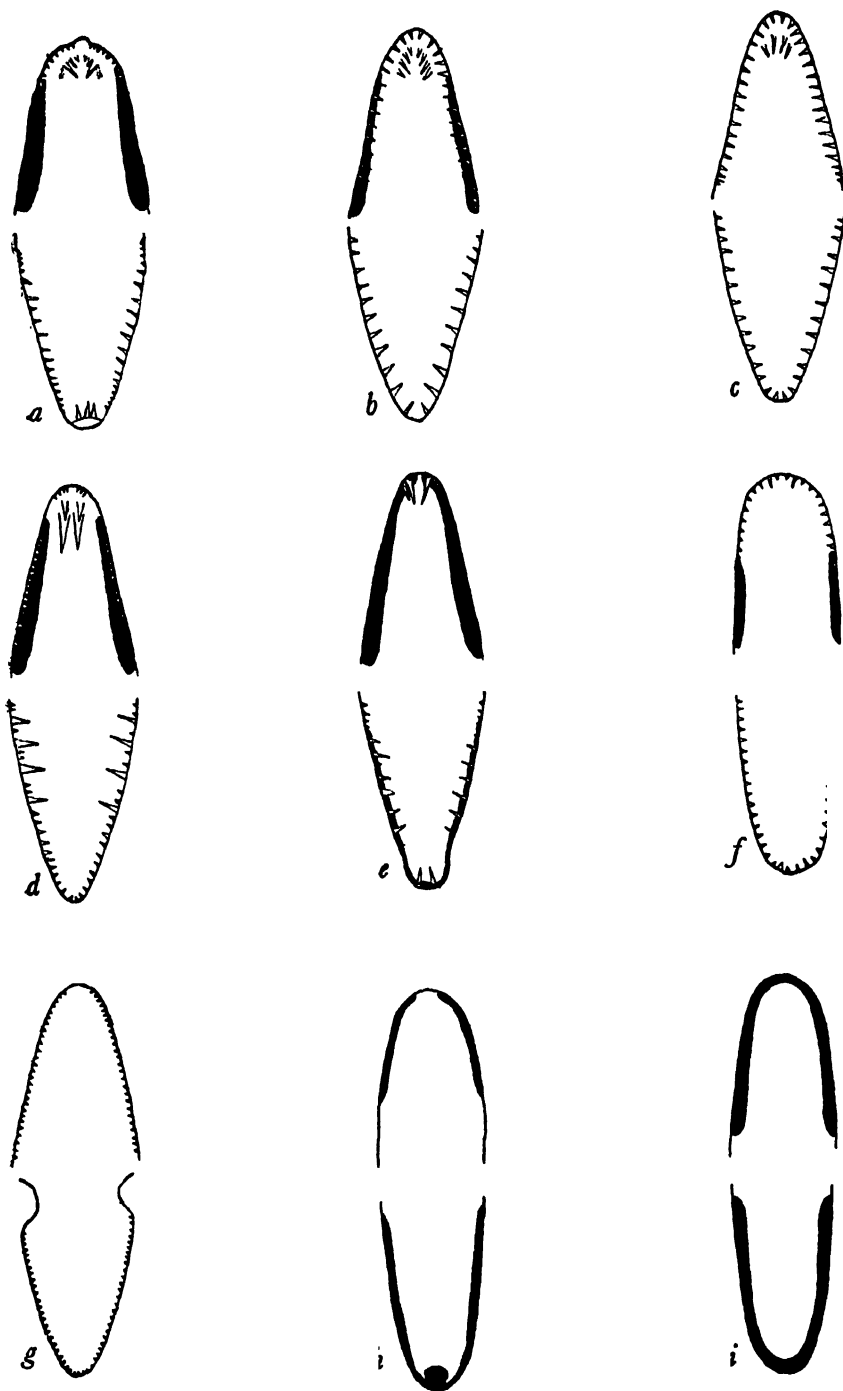


FIGURE 19.—See opposite page for explanation

dentary backward just above pectoral fin base and along base of anal fin, uniting into a single streak along midventral line of caudal peduncle; very intense black spot at midbase of caudal fin rays.

JADAMGA, new genus

FIGURE 20, c

This genus, based on the species *Jadamga quinquelineata* (Cuvier and Valenciennes), differs from the closely related genera *Cheilodipterus* and *Cheilodipterops* in regard to the teeth in the jaw, there being no canines at tip of lower jaw, as shown in figure 20, c, and in the key (p. 406).

Genotype.—*Cheilodipterus quinquelineatus** Cuvier and Valenciennes.

The diagram (fig. 20, c) is based on a sketch of the holotype by Chabanaud and on U.S.N.M. Nos. 52296 and 65976.

Genus SYNAGROPS Günther

FIGURE 19, c

Melanostoma STEINDACHNER and DÖDERLEIN, Denkschr. Akad. Wiss. Wien. math.-nat. Classe, vol. 48, p. 5, 1883. (Orthotype, *Melanostoma japonicum** Steindachner and Döderlein.)

*Synagrops** GÜNTHER, Report on the scientific results of the voyages of H. M. S. *Challenger* during the years 1873-76, vol. 22, pt. 57, p. 16, 1887. (Type, *Melanostoma japonicum* Steindachner and Döderlein; substitute name for *Melanostoma* Steindachner and Döderlein, preoccupied.)

Parascombrops ALCOCK, Journ. Asiat. Soc. Bengal, vol. 58, pt. 2, p. 296, 1889. (Type, *Parascombrops pellucidus* Alcock.)

*Hypoclydonia** GOODE and BEAN, Oceanic ichthyology, p. 236, 1895. (Type, *Hypoclydonia bella** Goode and Bean: U.S.N.M. No. 39338, type.)

*Amioides** SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 439, 1912. (Type, *Amia (Amioides) grossidens** Smith and Radcliffe: U. S. N. M. No. 70250, type.)

Maccullochina JORDAN, in Jordan and Jordan, Mem. Carnegie Mus., vol. 10, No. 1, p. 44, 1922. (Type, *Synagrops serratospinosa** Smith and Radcliffe: U.S.N.M. No. 70254, type.)

KEY TO THE SPECIES REFERRED TO SYNAGROPS

1a. Anterior edge of pelvic spines serrated.

2a. Anterior edge of second spine of first dorsal and of anal fin serrated.

3a. Anterior edge of spine in second dorsal serrated; no small keels on outer surface of posterior portion of preoperculum near lower angle.

serratospinosa Smith and Radcliffe

3b. Spine of second dorsal smooth; 2 or 3 small keels on outer surface of posterior portion of preoperculum near lower angle.

spinosa, new species

2b. Anterior edge of no spine in dorsal or anal fins serrated.

4a. No keels on outer surface of posterior portion of preoperculum near lower angle-----*philippinensis* (Günther)

4b. Three keels on outer surface of posterior portion of preoperculum near lower angle-----*argyrea* (Gilbert and Cramer)

1b. Anterior edge of pelvic spines smooth.

5a. One obviously strong humeral spine; margin of anterior ridge of preopercle smooth----- *grossidens* (Smith and Radcliffe)

5b. No humeral spines or at most only a rudiment of one; anterior ridge of preoperculum with a few serrations at lower angle.

6a. No keels on outer surface of posterior portion of preoperculum near lower angle; dorsal fins joined or practically so; Anal II, 9.

7a.⁵ About 40 scales in lateral line, depth $3\frac{1}{3}$ to $3\frac{1}{2}$ in length; eye $3\frac{1}{3}$ to $3\frac{3}{4}$ in head; gill rakers on lower half of first arch 13 or 14, formula 5+1+14----- *microlepis* Norman

7b. About 35 scales in lateral line; depth 3.3 in length; eye 2.9 in head; gill rakers on lower half of first arch 17 (total rakers 25)----- *pseudomicrolepis*, new species

6b. Two or three small keels on outer surface of posterior portions of preoperculum near lower angle; first and second dorsal fins definitely separated; about 30 scales in lateral line; depth $3\frac{3}{4}$ to more than 4 in length, eye 3 to $3\frac{1}{2}$ in head; anal II, 7.

8a.⁵ Maxillary to below center of eye, $2\frac{1}{4}$ to $2\frac{1}{3}$ in head.

bella (Goode and Bean)

8b.⁵ Maxillary to below anterior margin of pupil, $2\frac{1}{2}$ in head.

japonica (Steindachner and Döderlein)

SYNAGROPS SERRATOSPINOSA Smith and Radcliffe

*Synagrops serratospinosa** SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 444, pl. 38, fig. 2, 1912. (U.S.N.M. No. 70254, type.)

SYNAGROPS SPINOSA, new species

Holotype.—A male, 105 mm. in standard length, taken at *Albatross* station 2401, latitude $28^{\circ} 38' 30''$ N., longitude $85^{\circ} 52' 30''$ W., depth 142 fathoms, March 14, 1885 (Gulf of Mexico). This specimen was one of the cotypes of *Hypoclydonia bella* Goode and Bean. It bears U.S.N.M. No. 74324.

Description.—Body compressed, elongate with large cycloid scales, all except a few of which have been lost; lateral line continuous but not extending on caudal fin rays, except one or two pores; interorbital space slightly convex; premaxillaries protractile, lower jaw projecting but not entering profile, a small symphyseal knob on lower jaw fits into a concavity at symphysis of upper jaw; each side of tip of lower jaw is a concavity with narrow band of villiform teeth, upper edge of maxillary fitting into a groove formed by the suborbital and preorbital bones anteriorly, but mostly exposed posteriorly; near symphysis of premaxillaries occur a pair of canine teeth followed posteriorly by a band of villiform teeth; at symphysis of lower jaw is a pair of canine teeth that fit between those of upper

⁵ These portions of the key were taken from Norman, *Discovery Reports*, vol 12, p. 11, 1935. Our limited material does not indicate these differences when specimens of the same size are compared, and I am unable to find any character that will separate our Japanese and Atlantic material of *bella* and *japonica* with certainty.

jaws; posterior to the concavity near tip of lower jaw occur 5 and 8 canine teeth along midside of jaw behind which is a band of villiform teeth; small teeth on vomer and palatines; pelvics I, 5; the spine serrated on anterior edge; dorsal rays IX, I, 9, the anterior edge of second dorsal spine serrated beyond tip of first spine, no other spine in dorsal fins serrated; the space between dorsals equal to width of pupil; the third dorsal spine longest; anal rays II, 7, the anterior edge of the second spine serrated, beyond the tip of the first; pectoral rays

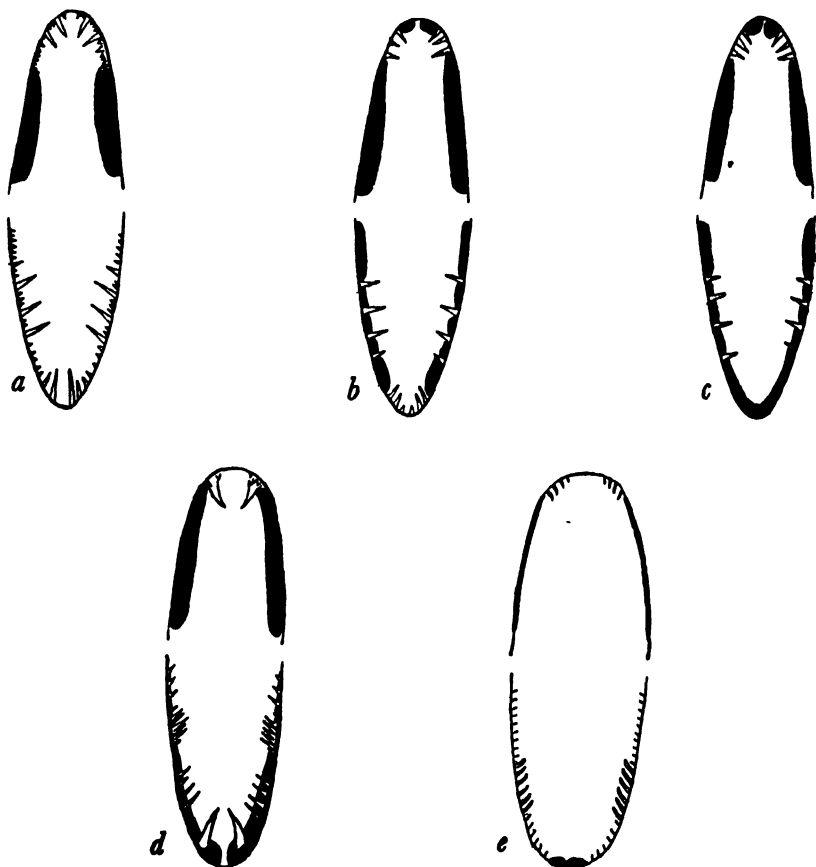


FIGURE 20.—Upper and lower jaws of cheilodipterid fishes, showing arrangement of the teeth; bands and patches of villiform teeth are blackened; white spots on black area represent canine teeth, usually in a single row along outer margin; vomerine and palatine teeth not shown: *a*, *Cheilodipterus*, diagram based on U.S.N.M. Nos. 30658 and 49287 (*C. lineatus*), 52410 and 65604 (*C. macrodon*), 30541 (probably *C. octovittatus*), and 37416 (type of *C. affinis*); *b*, *Cheilodipterops*, based on U.S.N.M. No. 30657 (holotype of *C. isostigma*); *c*, *Jadamga*, based on U.S.N.M. Nos. 52296 (7 specimens), 65976 (1 specimen), and the holotype from a sketch of *J. quinquelineata* by Chabanaud; *d*, *Neoscombrops*, based on a sketch by Barnard from a specimen of *N. annectens* in the South African Museum; *e*, *Gymnapogon*, based on U.S.N.M. No. 108821 (paratype of *G. japonicus*).

16 on each side; gill rakers on first arch 5+14; about 31 scale rows crossing lateral line; preoperculum with double edge, the lower angle of the anterior edge with fine serrations, the posterior edge completely serrated; operculum with two weak spines, edge smooth; suboperculum and interoperculum with a few weak serrations; inside of gill chamber blackish; peritoneum black, anus immediately in front of origin of anal fin; principal caudal rays 17; pseudobranchiae large; gill membranes extending far forward, free from isthmus except where they join it at its anterior tip; branchiostegals 6; caudal forked.

Measurements.—The measurements outside the parentheses are in millimeters, and those in parentheses are expressed in hundredths of the standard length. Distance from tip of snout to base of midcaudal fin rays 105; greatest depth of body 30.5 (29) at origin of spiny dorsal; least depth of caudal peduncle 11.9 (11.3); length from base of last anal ray to base of midcaudal fin rays 25 (23.8); head 37 (35.2); diameter of eye 10.8 (10.3); snout 9.0 (8.6); interorbital space 9.3 (8.9); length of longest pectoral fin ray 26 (24.8); length of second anal spine 9.6 (9.1); length of longest dorsal fin spine or third spine 17 (16.2); tip of snout to origin of spiny dorsal fin 38.7 (36.8); tip of snout to origin of anal fin 71.3 (68); tip of snout to insertion of pectoral fins 37 (35.2); tip of snout to insertion of pelvic fins 39.7 (37.8); tip of snout to center of anus 67.8 (64.5); length of maxillaries 16.6 (15.8); color in alcohol, silvery on sides and belly, darker above.

This species is distinguished from other species in the genus *Synagrops* as indicated in the key.

SYNAGROPS PHILIPPINENSIS (Günther)

*Acropoma philippinense** GÜNTHER, Zoology of the voyage of H. M. S. *Challenger*, vol. 1, pt. 6, p. 51, 1880.

Parascombrops pellucidus ALCOCK, Journ. Asiat. Soc. Bengal, vol. 58, pt. 2, p. 296, pl. 22, fig. 1, 1889.

Synagrops malayanus WEBER, Die Fische der Siboga-Expedition, p. 196, fig. 52, 1913.

SYNAGROPS ARGYREA (Gilbert and Cramer)

*Melanostoma argyreum** GILBERT and CRAMER, Proc. U. S. Nat. Mus., vol. 19, p. 416, pl. 39, fig. 3, 1897. (U.S.N.M. No. 47732, holotype.)

SYNAGROPS GROSSIDENS (Smith and Radcliffe)

*Amia (Amioides) grossidens** SMITH and RADCLIFFE, in Radcliffe, Proc. U. S. Nat. Mus., vol. 41, p. 440, pl. 36, fig. 1, 1912. (U.S.N.M. No. 70250, type.)

SYNAGROPS MICROLEPIS Norman

*Synagrops microlepis** NORMAN, *Discovery Reports*, vol. 12, Coast fishes, pt. 1: The South Atlantic, p. 12, fig. 3, 1935. (U.S.N.M. No. 108186, paratype.)

SYNAGROPS PSEUDOMICROLEPIS, new species

Holotype.—A male, 110 mm. in standard length, taken by the First Johnson-Smithsonian Deep-sea Expedition, March 4, 1933, and bearing tin tag number 599, station 100, latitude $18^{\circ} 38' 45''$ N., longitude $64^{\circ} 52' 45''$ W., to latitude $18^{\circ} 40' 15''$ N., longitude $64^{\circ} 50' 15''$ W., which is off the Virgin Islands. U.S.N.M. No. 107203.

Description.—Body compressed, elongate, with large cycloid scales, most of which have been lost; lateral line continuous but not extending on caudal fin rays; interorbital space nearly flat; head with numerous spongy cavities; premaxillaries protractile; lower jaw longer than upper, slightly projecting; upper edge of maxillaries fitting into a groove formed by the suborbital and preorbital bones, and anteriorly the maxillaries are covered by the preorbitals; wide band of villiform teeth on the premaxillaries, the very outer ones a little enlarged at each side of the symphysis of premaxillaries is a large canine tooth, on right side a smaller tooth at base of large one, between this pair of large canines fits the symphyseal knob and a smaller pair of canines on lower jaw; lower jaw with a narrow band of sharp villiform teeth anteriorly, but at sides of jaw gradually becoming enlarged canines in one row numbering 8 or 9, those in mid-side of jaw longest, and far apart; the region of the lower jaw at each side of the symphyseal canines is concave as in the genus *Synagrops*; teeth on vomer villiform in V-shaped patch, ending posteriorly in a few slightly enlarged teeth; palatine teeth small, conical in one or two irregular rows. Pelvics I, 5; dorsal rays IX, I, 10, a deep emargination in front of last spine and over ninth spine; first dorsal spine short, second about $2\frac{1}{2}$ times length of first, third spine longest; front edge of no spine in any fin serrated; preoperculum with double edge, the lower angle of the anterior edge with 5 or 6 short spines the posterior edge at lower angle serrated as is lower edge; at lower angle of preoperculum, outer surface of posterior plate without the small keels; operculum with two weak spines; suboperculum at lower corner with edge bearing a few serrae; interoperculum also with some serrae; inside of gill chamber blackish; peritoneum jet black; anus just in front of origin of anal fin; principal caudal rays 17; pseudo-branchiae present and large; gill membranes extending far forward free from isthmus; branchiostegals 7; first anal spine short, curved posteriorly, second anal spine long, broad, grooved behind.

Counts.—Dorsal rays IX, I, 10; anal rays II, 9; pectoral right 16, left 13?; gill rakers 7+1+17; scale formula about 3+35+?.

Measurements.—The measurements outside parentheses are in millimeters, and those in parentheses are expressed in hundredths of standard length. Distance from tip of snout to base of midcaudal fin rays 110; greatest depth of body 33 (30.0) near origin of spinous

dorsal fin; least depth of caudal peduncle 11.5 (10.5); length from base of last anal ray to base of midcaudal fin rays 18.8 (17.1); head 43 (39.1); diameter of eye 15 (13.6) snout 7.3 (6.64); interorbital space 10.5 (9.55); length of longest pectoral fin ray 33 (30.0); length of second anal spine 10.5 (9.55); tip of snout to origin of spiny dorsal fin 45.6 (41.5); tip of snout to origin of anal fin 75.6 (68.7); tip of snout to insertion of pectoral fins 42.6 (38.7); tip of snout to insertion of pelvic fin 44 (40.0); tip of snout to anus 70.6 (64.2); least width of bony suborbital 2.3 (2.18); length of maxillaries 21.3 (19.4).

Color in alcohol darker above; sides and belly silvery.

This species is distinguished from other species in the genus *Synagrops* as indicated in the key.

SYNAGROPS BELLA (Goode and Bean)

*Hypoclydonia bella** GOODE and BEAN, Oceanic ichthyology, p. 236, pl. 66, fig. 237, 1895. (U.S.N.M. No. 39338, type; Nos. 39346, 44621, 74325-74328, paratypes.)

TABLE 1.—Counts made on specimens of *Synagrops* in the U. S. National Museum

| Species | Dorsal rays | | | | | Anal rays | | | | Pectoral rays | | | | | | Scale rows crossing lateral line | | | | | | | | | |
|--------------------------------------|-------------|----|-----|-----|-----|-----------|-----|-----|-----|---------------|-----|-----|-----|-----|-----|----------------------------------|----------|----------|----------|----------|----------|----------|----------|-----|--|
| | IX | I | 8 | 9 | 10 | II | 7 | 8 | 9 | 14 | 15 | 16 | 17 | 18 | 19 | 25 26 | 27 28 | 29 30 | 31 32 | 33 34 | 35 36 | 37 38 | 39 40 | | |
| <i>serratospinosa</i> | 14 | 14 | --- | 13 | 1 | 14 | 14 | --- | --- | --- | --- | 6 | 5 | 2 | --- | --- | --- | 3 | --- | --- | --- | --- | --- | --- | |
| <i>spinosa</i> | 1 | 1 | --- | 1 | --- | 1 | 1 | --- | --- | --- | --- | 2 | --- | --- | --- | --- | --- | --- | 1 | --- | --- | --- | --- | | |
| <i>philippinensis</i> | 18 | 19 | 1 | 17 | --- | 18 | 17 | --- | --- | --- | --- | 5 | 9 | 4 | --- | --- | 1 | 3 | --- | --- | --- | --- | --- | | |
| <i>argyrea</i> | 1 | 1 | --- | 1 | --- | 1 | 1 | --- | --- | 1 | 1 | --- | --- | --- | --- | --- | 1 | 1 | --- | --- | --- | --- | --- | | |
| <i>grossidens</i> | 1 | 1 | --- | --- | 1 | 1 | --- | 1 | --- | 1 | --- | --- | --- | --- | --- | 1 | --- | --- | --- | --- | --- | --- | --- | | |
| <i>microlepis</i> ¹ | 1 | 1 | --- | --- | 1 | 1 | --- | --- | 1 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 1 | | |
| <i>pseudomicrolepis</i> | 1 | 1 | --- | --- | 1 | 1 | --- | --- | 1 | --- | --- | 1 | --- | --- | --- | --- | --- | --- | --- | 1 | --- | --- | --- | | |
| <i>bella</i> | 13 | 13 | --- | 13 | --- | 13 | 13 | --- | --- | --- | --- | 9 | 3 | --- | 1 | --- | --- | 1 | 2 | --- | --- | --- | --- | | |
| <i>japonica</i> | 2 | 2 | --- | 2 | --- | 2 | 2 | --- | --- | --- | --- | 2 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | |

| Species | Gill rakers on lower half of arch | | | | | | | Total gill rakers on first gill arch | | | | | | | | | | |
|--------------------------------------|-----------------------------------|-----|-----|-----|-----|-----|-----|--------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| <i>serratospinosa</i> | 5 | 6 | 1 | 1 | --- | --- | --- | 5 | 5 | 2 | 1 | --- | --- | --- | --- | --- | --- | --- |
| <i>spinosa</i> | --- | --- | --- | 1 | --- | --- | --- | --- | --- | --- | --- | 1 | --- | --- | --- | --- | --- | --- |
| <i>philippinensis</i> | 4 | 3 | 2 | 3 | 3 | 3 | --- | 3 | 3 | --- | 2 | 3 | 3 | 4 | --- | --- | --- | --- |
| <i>argyrea</i> | --- | 1 | --- | --- | --- | --- | --- | --- | --- | 1 | --- | --- | --- | --- | --- | --- | --- | --- |
| <i>grossidens</i> | --- | --- | 1 | --- | --- | --- | --- | --- | --- | --- | 1 | --- | --- | --- | --- | --- | --- | --- |
| <i>microlepis</i> ¹ | --- | --- | 1 | 1 | --- | --- | --- | --- | 1 | 1 | --- | --- | --- | --- | --- | --- | --- | --- |
| <i>pseudomicrolepis</i> | --- | --- | --- | --- | --- | --- | 1 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 1 |
| <i>bella</i> | --- | --- | 4 | 6 | 2 | --- | --- | --- | --- | --- | 1 | 4 | 6 | 2 | --- | --- | --- | --- |
| <i>japonica</i> | --- | --- | 2 | --- | --- | --- | --- | --- | --- | --- | 1 | 1 | --- | --- | --- | --- | --- | --- |

¹ Data for one of these specimens of *S. microlepis* were taken from Norman, *Discovery Reports*, vol. 12, 1935.

SYNAGROPS JAPONICA (Steindachner and Döderlein)

*Melanostoma japonicum** DÖDERLEIN, in Steindachner and Döderlein, Denkschr. Akad. Wiss. Wien. math.-nat. Classe, vol. 48, p. 5, pl. 1, fig. 2, 1883.

Synagrops natalensis GILCHRIST, Fish. and Mar. Biol. Surv. South Africa, Rept. No. 2, special rept. III, p. 69, 1922.

Genus TELESCOPIAS Jordan and Snyder *

FIGURE 19, c

*Telescopias** JORDAN and SNYDER, Proc. U. S. Nat. Mus., vol. 23, p. 909, pl. 44, 1901. (Orthotype, *Telescopias gilberti* Jordan and Snyder: U.S.N.M. No. 57540, paratype.)

Genus PSEUDAMIA Bleeker

Pseudamia BLEEKER, Nederl. Tijdschr. Dierk., vol. 2, p. 284, 1865. (Type, *Apogon polystigma* Bleeker.)

Genus GYMNAPOGON Regan *

FIGURE 20, e

*Gymnapogon** REGAN, Ann. Mag. Nat. Hist., ser. 7, vol. 15, p. 19, 1905. (Orthotype, *Gymnapogon japonicus* Regan; U.S.N.M. No. 108821, paratype.)

Genus SCOMBROPS Temminck and Schlegel *

FIGURE 19, b

*Scombrops** TEMMINCK and SCHLEGEL, Siebold's Fauna Japonica, Pisces, p. 118, 1849. (Orthotype, *Scombrops cheilodipterus* Bleeker=*Scomber boops* Houttuyn.)

Latebrus POEY, Mem. Hist. Nat. Cuba, vol. 2, pt. 2, p. 168, 1860. (Orthotype, *Latebrus oculatus* Poey.)

Genus NEOSCOMBROPS Gilchrist

FIGURE 20, d

*Neoscombrops** GILCHRIST, Fish. and Mar. Biol. Surv. South Africa Rept. No. 2, special rept. III, p. 67, 1922. (Genotype, *Neoscombrops annectens* Gilchrist.)

Erythrobusssothen PARR, Bull. Bingham Oceanogr. Coll., vol. 3, art. 6, p. 31, fig. 14, 1933. (Genotype, *Erythrobusssothen gracilis* Parr.)

Genus HOWELLA Ogilby

Howella OGILBY, Proc. Linn. Soc. New South Wales, vol. 33, p. 734, 1899. (Orthotype, *Howella brodiei* Ogilby.)

Galeagra HELLER and SNODGRASS, Proc. Washington Acad. Sci., vol. 5, p. 193, 1903. (Orthotype, *Galeagra pammelas* Heller and Snodgrass.)

Rhectogramma NORMAN, Discovery Reports, vol. 2, p. 348, fig. 39, 1930. (Genotype, *Rhectogramma sherborni* Norman.)

Sphyaenops GILL, in Poey, Mem. Hist. Nat. Cuba, vol. 2, p. 349, 1860. (Orthotype, *Sphyaenops bairdianus* Poey.)

*The placing of *Scombrops*, *Telescopias*, and *Gymnapogon* in the family Pomatomidae by Regan (Ann. Mag. Nat. Hist., ser. 8, vol. 12, pp. 117-118, 1913) does not seem justified to me at this time. Further study is necessary to establish relationships.

Genus **BATHYSPHYRAENOPS** Parr

Bathysphyraenops PARR, Bull. Bingham Oceanogr. Coll., vol. 3, art. 6, p. 28, fig. 13, 1933. (Genotype, *Bathysphyraenops simplex* Parr.)

Genus **APOGONOPS** Ogilby

FIGURE 19, *g*

Apogonops OGILBY, Proc. Linn. Soc. New South Wales, vol. 21, p. 23, 1896. (Orthotype, *Apogonops anomalus* Ogilby.)

Parasphyraenops T. H. BEAN, Proc. Biol. Soc. Washington, vol. 25, p. 124, 1912. (Orthotype, *Parasphyraenops atrimanus** Bean: U.S.N.M. No. 74085, type.)

Genus **BREPHOSTOMA** Alcock

Brephostoma ALCOCK, Ann. Mag. Nat. Hist., ser. 6, vol. 4, p. 383, 1889. (Orthotype, *Brephostoma carpenteri* Alcock.)

Genus **BRINKMANNELLA** Parr

Brinkmannella PARR, Bull. Bingham Oceanogr. Coll., vol. 3, art. 6, p. 26, fig. 12, 1933. (Genotype, *Brinkmannella elongata* Parr.)



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A CONTRIBUTION TO THE KNOWLEDGE OF THE
EUCHARIDAE (HYMENOPTERA: CHALCIDOIDEA)

By A. B. GAHAN

THE following notes and descriptions are published principally in order to make names available for various species of Eucharidae that have been submitted for determination.

Family EUCHARIDAE

The family Eucharidae is an extensive one, comprising many of the most striking forms to be found in the Chalcidoidea. It is evident that only relatively few of the existing species as yet have been described. In view of the many weird and unusual forms to be found in the family, one might expect their classification to be an easy matter, but such is not the case. Supposed generic distinctions often intergrade, making it difficult to be sure of the correct placement for a given species, and specific distinctions are often extremely subtle, consisting of slight differences in sculpture that are hard to describe and may easily be overlooked. So far as known all the species are parasites of Formicoidea or at least associated with ants, and the biologies of the few species of which the habits are known are not only very interesting but quite complicated.

Genus EUCHARIS Latreille

EUCHARIS SCUTELLARIS, new species

Closely resembles *adscendens* Fabricius, as that species stands represented in the National Museum by specimens identified by Dr. F.

Ruschka, but may be distinguished at once by the rugosely sculptured scutellum and the fact that the scutellum is not bidentate at apex.

Female.—Length 6 mm. Head and thorax dark metallic green, abdomen mostly black but with the apical margin of second tergite, all of third, fourth, and fifth tergites yellow, the two apical tergites black; antennae entirely black; legs mostly yellowish testaceous but with the femora pitchy black and the coxae concolorous with the thorax; tegulae dark brown or blackish; wings nearly uniformly light brownish, the middle of disk a little paler; venation dark brown.

Head viewed from in front much broader than high and not nearly so wide as thorax; frons and vertex rugosely sculptured; face, cheeks, and lower part of temples sparsely punctate; clypeus perfectly smooth, its anterior margin very nearly straight; supraclypeal area mostly smooth and very indistinctly (sometimes not at all) separated from the clypeus; ocelli large, in a very low triangle; ocellocular line not longer than the diameter of a lateral ocellus, the area between posterior ocellus and eye margin deeply depressed. Mesoscutum and axillae smooth and shining but with very fine punctures sparsely scattered over the surface; parapsidal grooves sharply impressed, complete, and finely foveolated; groove at base of scutellum deep and coarsely foveated; scutellum rugoso-punctate, with a deep longitudinal groove down the middle and a slightly elevated protuberance at dorsal apex which is not emarginate, the transverse groove obscured by the rugose sculpture; metanotum rugose; propodeum nearly uniformly rugulose, without carinae, the spiracular furrows broad and deep; sides of pronotum strongly rugose; prepectus not distinctly separated from pronotum; mesothoracic spiracle plainly exposed; mesopleura mostly smooth, with sparse small punctures similar to those on mesoscutum but more or less strongly wrinkled along the margins and on lower half, the femoral furrow deep and with coarse transverse rugae. Anterior coxae rugulosely sculptured, the median and posterior pairs nearly smooth; anterior and median femora distinctly shorter and thicker than the posterior pair. Abdominal petiole two and one-half to three times as long as broad, rugulosely sculptured above on basal half, smooth on apical half, entirely smooth beneath, nearly parallel-sided throughout most of its length but rather abruptly narrowed near base, and with a deep longitudinal median groove both above and beneath; gaster somewhat smaller than the thorax, mostly smooth and polished but with ultimate and penultimate segments as well as the basal middle of fifth tergite, finely punctate.

Antennal scape, exclusive of radicle, about as broad as long; pedicel broader than long; flagellum 8-jointed, not serrate, the apical joints usually a little narrower than the basal ones; first funicular joint about

twice as long as broad, thicker at apex than at base; second joint distinctly a little longer than broad; third, fourth, fifth, and sixth joints barely longer than broad, the seventh very slightly broader than long; eighth, or club, joint apparently undivided and one and one-half to two times as long as the preceding joint.

Forewing a little more than two and one-half times as long as broad, without marginal cilia and with rather weak discal cilia, the base bare; marginal vein very slightly thicker at base than at apex, postmarginal vein subobsolete, stigmal vein subtriangular and approximately as broad as long.

Male.—Length 5.5 mm. Antennal flagellum 10-jointed, the first joint about two and one-half times as long as broad; second to seventh joints each approximately twice as long as broad; eighth to tenth joints as distinctly separated as the others and each as long as the seventh joint or only slightly shorter. Abdominal petiole about four times as long as broad, about as long as posterior femur and a little more slender than in the female; gaster all black, much smaller than the thorax with the punctation of the apical three tergites similar to that of female but not quite so extensive. Otherwise like the female.

Type locality.—Suigen, Chosen.

Type.—U.S.N.M. No. 53548.

Described from 10 females (one holotype) and 11 males (one allotype) reared by C. P. Clausen from cocoons of *Formica* sp. in June 1928 under Clausen No. 2300.

Genus *PSILOGASTER* Blanchard

PSILOGASTER ANTENNATUS, new species

In Ashmead's key to the genera of Eucharidae,¹ this species runs straight to *Psilogaster*, agreeing with all the characters cited except that the joints of the funicle are all short, subequal, and subquadrate or barely longer than broad, instead of elongate as usual in the genus. The club of the antenna is indistinctly divided into three segments by very shallow transverse grooves so that the antenna might be said to be 13-jointed instead of 11-jointed. If considered to have 13-jointed antenna the species would run to *Orasema* in the key, but it differs from typical species of that genus by having the ovipositor very slender and entirely devoid of saw-like teeth, by having the abdominal petiole longer and much more slender, and by lacking a distinct cross-furrow on the scutellum. No representative of *Psilogaster* is at hand for comparison, but the species seems to fit best in that genus and accordingly is placed there pending a better understanding of the genera.

Female.—Length 2 mm. Head impunctate, highly polished, black with a strong strong metallic bluish-green tinge on frons, face, and cheeks;

¹ Mem. Carnegie Mus., vol. 1, p. 207, 1904.

thorax rugoso-reticulate, brownish black; antennae entirely, all legs including their coxae and the abdominal petiole pale yellow; all coxae and petiole of abdomen smooth; abdomen, except petiole, polished, black; mouth parts pale yellowish, mandibles blackish at apex; wings hyaline. Antenna 11-jointed; scape subcylindrical, five or six times as long as broad, about equal in length to five following joints combined; pedicel about twice as long as broad; ring joint subquadrate; seven joints of funicle subequal and subquadrate or very slightly longer than broad; club not thicker than funicle, very slightly longer than two preceding funicle joints together, practically solid but with distinct traces of two transverse furrows. Head transverse, much wider than thorax, perfectly smooth except for a few very weak and irregularly transverse lines on the occiput; occiput very slightly concave; ocelli in a nearly right-angled triangle, postocellar line distinctly shorter than ocellocular line; frons practically without scrobes; clypeus polished, nearly twice as wide as long, its anterior margin broadly rounded; clypeal foveae and groove distinct but very shallow; supraclypeal area not defined, i. e., not limited laterally by grooves; malar space a little shorter than length of eye; mandibles long and curved, the right with three teeth, the left with two. Thorax short, moderately convex, with nearly uniform coarse reticulation; pronotum concealed from above; parapsidal grooves complete and distinct; scutellum nearly round, not especially convex and without a transverse furrow but with an irregular transverse carina in the normal place for the furrow; propodeum about as long as scutellum and with similar coarse reticulate sculpture, without definite median carina and without lateral folds, spiracular sulci present but obscured by the rough sculpture; legs rather slender, their coxae and femora smooth; forewing normal in size, bare from base to a little beyond apex of submarginal vein, moderately ciliated beyond that point and with a few hairs in the costal cell; marginal fringe rather short; veins very slender, the marginal vein about half as long as submarginal; stigmal vein very short, postmarginal two or three times as long as stigmal. Abdomen including the petiole about twice as long as thorax; petiole as long as gaster, very slender, and slightly bowed from end to end; gaster triangular in lateral profile, perfectly smooth and shining; ovipositor slender, apparently straight, and without distinct teeth, normally concealed.

Male.—Length 1.9 mm. Almost indistinguishable from the female except by the genitalia. The antennae are very slightly more slender with the hairs a little longer. The abdominal petiole is practically the same as in the female and the gaster is a very little smaller.

Type locality.—Kuala Lumpur, Federal Malay States.

Type.—U.S.N.M. No. 53549.

Holotype female, allotype male, and 23 paratypes collected by C. P. Clausen, at the type locality in February 1930 under Clausen No. 2432. Also 1 paratype taken at quarantine in Honolulu, Hawaiian Islands, May 8, 1931, on *Coelogyne* sp. from Straits Settlements.

Genus PARAPSILOGASTER Girault

PARAPSILOGASTER LAEVICEPS, new species

I am in some doubt as to the true generic position of this insect. The antennae are 12-jointed. The ring joint is entirely absent, and the club has three rather distinct although imperfectly separated joints. The head is perfectly smooth, the occiput rather deeply concave and the angle formed by it with the vertex sharp and margined by a weak carina behind and very close to the ocelli. The mandibles are as in *Orasema*. The labial palpi are 3-jointed, as are also the maxillary palpi. The pronotum is mostly concealed from above, the mesoscutum short, strongly declivous anteriorly and weakly rugulose, with the parapsidal grooves deep and complete. The axillae are broadly united medially and weakly longitudinally wrinkled. The scutellum has a transverse fold at its apical one-third, is perfectly smooth behind the fold but irregularly rugulose in front of it, and is entirely without processes. The propodeum is about as long as the dorsal aspect of scutellum before the fold, mostly smooth, without lateral folds and usually without a median carina, the spiracular grooves well defined. The legs are slender, their tarsi normal. The abdominal petiole is irregularly longitudinally rugulose, about twice as long as the posterior coxae and not especially slender. The gaster is smooth, strongly elevated, its ventral length subequal to the length of petiole, its height nearly twice its ventral length. The ovipositor is thick and armed with very distinct saws. The wings are normal, the costal cell moderately broad, the stigmal vein short and sessile, and the postmarginal vein weak but longer than stigmal.

The above characters, except for the smooth head, long abdominal petiole, and possibly the number of joints in the palpi, seem to agree fairly well with the characters for *Parapsilogaster* Girault as given by Girault² and amplified by Ishii.³ No authentic representatives of *Parapsilogaster* are available for comparison, and it is quite possible that this new species may eventually be found to represent a new genus.

Female.—Length 2 mm. Head polished, thin anteroposteriorly; ocelli in a very low triangle, almost in a straight line; postocellar and ocellocular lines subequal; scrobes distinctly impressed, moderately deep; clypeus a little broader than long, polished, its anterior

² Mem. Queensland Mus., vol. 4, p. 232, 1915.

³ Bull. Imp. Agr. Exp. Stat. (Tokyo), vol. 3, p. 204, 1932.

margin very strongly convexly rounded; clypeal foveae large and deep and the clypeal sutures very distinct; supraclypeal area distinctly set off by shallow sutures running from the antennal foramina to the clypeal foveae; labrum with four digits; malar space about equal to the length of eye; eyes bare. Antennal scape clavate, slender at base but becoming thicker toward apex, not quite reaching to anterior ocellus; pedicel short, cup-shaped; funicle joints from first to last successively decreasing in length, the first about three times as long as broad and about one and one-half times the length of the second, the seventh about as long as broad; club a little longer than the two preceding funicle joints combined, 8-jointed, the sutures usually distinct but not deep. Mesoscutum finely irregularly wrinkled, its lateral lobes smooth posteriorly; parapsidal grooves deep and not or very weakly foveolate; sutures separating axillae from scutellum strongly foveated, the carinae separating these foveae continued over the axillae as very fine, widely separated, and more or less parallel and oblique rugae; scutellum longer than broad, dorsally sculptured like the prescutum, smooth at apex, the transverse fold not deeply impressed; propodeum about as long as posterior coxae, mostly smooth but usually with some obscure reticulation along the basal margin and down the middle, the spiracular sulci not foveated; pleura mostly smooth and polished. All coxae smooth; femora and tibiae moderately slender, without sculpture; basal joint of hind tarsi about as long as the three following joints combined; posterior tibia apparently with only one spur. Forewing bare basally behind the submarginal vein, this bare area with a triangular extension a little before the middle of wing and reaching approximately half the length of marginal vein, the rest of wing disk rather densely ciliated; costal cell moderately broad and nearly uniformly ciliated; marginal cilia extremely short, almost absent; hind wing uniformly ciliated from base to apex and with distinct marginal cilia. Segments of gaster apparently not incised medially, all except the first short and subequal. Head, thorax, abdomen, and all coxae black, the thorax with a slight bluish tinge and the gaster faintly coppery; femora all dark brown; trochanters, narrow apices of all femora, all tibiae, all tarsi, the tegulae, and the antennae, yellowish testaceous, the antennal flagellum becoming brownish toward apex; wings hyaline.

Male.—Unknown.

Type locality.—Peradeniya, Ceylon.

Type.—U.S.N.M. No. 53550.

Type and 3 paratypes taken in the above named locality by C. P. Clausen in February 1930 and bearing his number 2435; also 1 specimen taken at the same place July 25, 1913, by an unknown collector.

Genus **CHALCURA** Kirby**CHALCURA DEPRIVATA** (Walker)

Thirty specimens comprising both sexes and labeled "Ex *Odontomachus haematodes* (Linnaeus) ; Peradeniya, Ceylon, February 1930; C. P. Clausen collector, No. 2434" have been identified as this species.

Genus **KAPALA** Cameron**KAPALA TERMINALIS** Ashmead

Fifty specimens taken by C. P. Clausen at Hoyo Colorado, Cuba, in July and bearing his numbers 2453 and 2451 agree nicely with a paratype of this species in the National Museum collection. The species was originally described from Cuba, the exact locality not stated. Two specimens received from S. C. Bruner were also taken in Cuba, one at Sierra Rangel, Pinar del Rio, and the other at Manacas, Santa Clara. One specimen received from G. N. Wolcott, taken at Port au Prince, Haiti, in February 1925 seems also to belong to this species.

KAPALA FURCATA (Fabricius)

Thirteen specimens bearing C. P. Clausen No. 2447, and taken January 2, 1931, on Barro Colorado Island, Panama Canal Zone, ovipositing in flower buds, seem to agree with Ashmead's identification of this Fabrician species. Other material in the collection indicates a distribution for this species extending from Brazil through Venezuela, Colombia, Panama, St. Vincent, Grenada, and Mexico to Brownsville, Tex.

Genus **SCHIZASPIDIA** Westwood**SCHIZASPIDIA CONVERGENS** (Walker), new combination

Eucharis convergens WALKER, Ann. Mag. Nat. Hist., ser. 3, vol. 6, p. 358, 1860.

Seven female and fifteen male specimens labeled "ex *Odontomachus haematodes* (L.) ; Peradeniya, Ceylon, February 1930; C. P. Clausen collector, No. 2433" seem to agree very well with Walker's description of *Eucharis convergens* and are believed to be that species.

This species is obviously very similar to *Schizaspidia furcifera* Westwood, the type species of *Schizaspidia*, and I believe should be referred to that genus. It differs from the description and figures of *furcifera* by having the first joint of the flagellum in the female nearly twice as long as the pedicel, joints 2 to 8 of the flagellum much less strongly produced dorsally, the ninth or apical joint very little longer than broad and with one more or less obscure constriction, the antenna therefore apparently 12-jointed instead of 13-jointed. The scutellum is not distinctly longitudinally striated but is shallowly

and irregularly rugose with only one or two weak longitudinal rugae laterally.

The species closely resembles *antennata*, the new species described herewith, but differs in the following respects: Flagellar joints in the female less strongly produced dorsally, the longest tooth being much shorter than the length of the segment; ninth flagellar joint closely fused with the tenth, often hardly distinguishable, the antennae therefore often appearing to be only 11-jointed; transverse rugae on mesoscutum a little less coarse, the surface of mesoscutum therefore more shining; parapsidal grooves complete but not deeply impressed and with some of the transverse rugae continuous from the middle lobe of mesoscutum onto the scapulae; axillae and scutellum not distinctly longitudinally striated but weakly irregularly rugose and shining, and the median groove on scutellum broad and shallow; scutellar process almost exactly like that of *antennata* but the apex of scutellum beneath the process nearly smooth; propodeum irregularly rugulose, more or less shining except laterally; abdominal petiole very nearly smooth; second tergite sparsely punctate, the punctures most numerous on the sides of tergite; ovipositor slender, perfectly straight, and armed with only about three or four very weak teeth apically; hypopygium apparently with only five or six long hairs at its apex.

The male differs from the male of *antennata* by having the first flagellar joint without a dorsal tooth, the branches on joints 2-9 slightly longer and not quite so broadly compressed, the clypeus and supraclypeal area polished like the rest of face, mesoscutum with the median lobe irregularly transversely rugoso-striate, the rugae continuous across the parapsidal grooves onto the scapulae, scutellum and axillae not longitudinally striated but coarsely rugoso-punctate, apex of scutellum beneath the apical process and also the propodeum strongly rugoso-punctate, abdominal petiole about one and one-half times the length of posterior coxae and practically smooth.

The straight, slender, and weakly toothed ovipositor, when compared with the strongly curved, thicker, and strongly toothed ovipositor of *antennata*, indicates a different method of oviposition and suggests the possibility that the two species do not belong in the same genus. The ovipositor of *convergens* is similar to that of at least some of the species of *Stilbula* but the fact that the flagellar joints in the female are serrate, and in the male have long branches, at once excludes it from that genus. Its great similarity to *antennata* in all respects, except the ovipositor, constrains me to believe the two should be placed in the same genus and that both are congeneric with *Schizaspidia furcifera* Westwood.

SCHIZASPIDIA ANTENNATA, new species

Agrees very well with the description of *furcifera* Westwood except that in the female the third joint of the antenna is very nearly or quite twice as long as the second, the eleventh joint is distinctly separated from the twelfth and produced laterally like the preceding joints, while the twelfth joint is very short, almost globose, and apparently undivided.

Female.—Length 3 mm. Head, thorax, propodeum, and abdominal petiole dark green; gaster brownish black; antenna dark brown, the scape and pedicel paler; coxae all dark brown, rest of legs yellowish testaceous; tegula testaceous; wings mostly hyaline but with a broad indefinitely delimited brownish fuscous band embracing the stigmal vein and extending across the wing nearly to the posterior margin.

Head with vertex and occiput transversely striated, upper part of frons between scrobe and eye margin with weak longitudinal striae, temples weakly longitudinally rugulose, lower part of frons, face, clypeus and anterior portion of malar space perfectly smooth and polished; malar space a little shorter than eye; ocelli in a slightly curved line, the posterior ocellus about twice its own diameter from the eye margin. Mesoscutum with complete and widely separated parapsidal grooves, its median lobe strongly transversely rugoso-striate, the lateral lobes also transversely rugoso-striate bordering the parapsidal grooves but more coarsely and irregularly rugose laterally; axillae and scutellum coarsely longitudinally striated, the scutellum with a deep median longitudinal groove and with the forked process at apex about as long as the scutellum itself, this process grooved medially, more or less striated laterally, the tines of fork nearly smooth and carinately margined; apex of scutellum beneath the process irregularly rugose; propodeum rugose, without carinae, and with the spiracular furrows shallow and obscured by the rough sculpture; pleura mostly rugose but with the mesepisternal plate partly smooth. Coxae smooth; femora smooth and all moderately slender. Abdominal petiole a little longer than posterior coxae, broader at apex than at base and rugulosely sculptured; gaster smooth, not as large as thorax, the hypopygium at apex with about 20 long stiff hairs; ovipositor strongly curved downward the dorsal valves each with about 8 distinct transverse ridges or teeth.

Antenna 12-jointed, without a ring joint; scape cylindrical, not quite reaching to anterior ocellus; pedicel about as long as broad; flagellum strongly serrate, the first flagellar joint about twice as long as pedicel and not prolonged into a tooth dorsally; second to ninth

flagellar joints above at apex each produced into a strong tooth which on the middle joints is a little longer than the body of the segment; tenth or apical joint nearly globose or a little broader than long and apparently not divided.

Forewing about two and one-half times as long as broad, bare at base for a little more than half the length of submarginal vein, this bare area prolonged along the posterior margin of wing about to apex of submarginal vein; costal cell nearly uniformly ciliated; ciliation on disk of wing rather dense; marginal cilia very short, absent on apex of wing; stigmal vein about one-fourth as long as marginal, postmarginal about half as long as marginal.

Male.—Length 3 mm. Antennal scape very slightly swollen, approximately thrice as long as broad, pedicel a little broader than long; first flagellar joint with a cone-shaped dorsal tooth, which is about as long as the body of the segment, second to ninth flagellar joints each with a much longer and distinctly compressed branch, the ones on the fourth and fifth segments longest and about four or five times as long as the one on the first segment; tenth joint without a branch and about equal in length to the branch on the ninth segment. Clypeus and supraclypeal area transversely striated. Median lobe of mesoscutum transversely rugoso-striate, the lateral lobes irregularly rugose with little or no indication of striation; axillae rugose; scutellum coarsely longitudinally striate; apex of scutellum beneath the apical process more strongly rugoso-punctate than in the female; propodeum coarsely rugoso-punctate; abdominal petiole about one and one-half times as long as posterior coxa, not broader at apex than at base and distinctly rugose. Otherwise like the female.

Type locality.—Kuala Lumpur, Federated Malay States.

Type.—U.S.N.M. No. 53551.

Described from 4 females and 2 males taken in June 1930 by C. P. Clausen and bearing his number 2439.

Genus STILBULA Spinola

STILBULA TENUICORNIS (Ashmead), new combination

Schizaspidia tenuicornis ASHMEAD, Journ. New York Ent. Soc., vol. 12, p. 151, 1904.—CLAUSEN, Ann. Ent. Soc. Amer., vol. 16, p. 215, 1923.—PARKER, Ann. Soc. Ent. France, vol. 98, p. 270, 1924.

The type of this species, as well as a series of 6 specimens from Koiwai, Japan, and 60 specimens from Suigen, Chosen, including numerous representatives of both sexes, has been examined. The elongate and cylindrical flagellar joints in both sexes, the short and bispinose scutellar process, the very narrow costal cell, the very broad and deep spiracular grooves on the propodeum, and a distinct hump

or elevation on the propodeum laterad of each spiracle place the species in the genus *Stilbula* instead of *Schizaspidia*. In fact, I am able to distinguish these specimens from *S. cyniformis* (Rossi) ⁴ (type of the genus), as represented by European specimens identified by F. Ruschka, only by the fact that the face of the Japanese form is more distinctly transversely striated and the coarse punctures constituting the sculpture of scutellum are somewhat smaller and correspondingly more numerous than in the European form. These differences are not very pronounced, and it seems quite possible that *S. tenuicornis* is merely a geographical race of *S. cyniformis*.

STILBULA POLYRACHICIDA (Wheeler and Wheeler), new combination

Schizaspidia polyrachicida WHEELER and WHEELER, Psyche, vol. 31, p. 49, 1924.

This species, which is represented in the National Museum by one female specimen (the type), apparently belongs in *Stilbula*. The flagellar joints are cylindrical, not serrate, the scutellar process is short, the spiracular furrows on propodeum are broad and deep, and there is a more or less distinct elevation laterad of the spiracle.

The species is readily distinguished by a broad, deep, rounded pit at the base of the scutellum between the axillae (not on the metanotum as stated in the original description).

STILBULA FLORIDANA (Ashmead), new combination

Lophyrocera floridana ASHMEAD, Ent. Amer., vol. 3, p. 187, 1888.

This species is excluded from *Lophyrocera* by the fact that the propodeum is without toothlike processes. The only female representative of this species in the U. S. National Museum collection lacks the head, but the species is so nearly identical with *septentrionalis* (Brues) that it seems safe to assume that the antennae, like those of *septentrionalis*, are not serrate, a character that would also throw it out of *Lophyrocera*. The antennae of the male have the flagellar joints long and cylindrical, and the other essential generic characters are those of *Stilbula*.

STILBULA SEPTENTRIONALIS (Brues), new combination

Schizaspidia septentrionalis BRUES, Bull. Wisconsin Nat. Hist. Soc., vol. 5, p. 104, 1907.

The type of this species, formerly in the Brooklyn Museum but now in the U. S. National Museum, is apparently congeneric with the

⁴ This species name was emended by Kirby (Journ. Linn. Soc. London, Zool., vol. 12, p. 31, 1886) to *cynipiformis*, and the emendation has been accepted by some subsequent authors. The emendation, however, seems equally as incorrectly formed as the original spelling, and since any change of the name was unnecessary, I prefer to use the original spelling.

other species here transferred to the genus *Stilbula*. It is easily distinguished from the other species known to me, except *floridana* (Ashmead), by its different coloration and also by having the propodeum deeply and broadly hollowed out medially, this median depression as well as the broad spiracular furrows with coarse transverse striae, the surfaces between the median depression and the spiracular grooves very prominent and very coarsely rugose. The propodeum laterad of the spiracle is not strongly elevated as in some of the species.

The species is very similar to *floridana* (Ashmead), apparently differing only by having the thorax more distinctly and more extensively marked with black.

STILBULA MANIPURENSIS (Clausen), new combination

Schizaspidia manipurensis CLAUSEN, Proc. Ent. Soc. Washington, vol. 30, pp. 80-86, 1928.

In this species the antennae of both sexes are long and cylindrical, the scutellar process is comparatively short, and the costal cell is not especially broad. These characters place the species in *Stilbula* instead of *Schizaspidia*, although the propodeum is without the pronounced elevations laterad of the spiracles usually characteristic of *Stilbula*.

The characters pointed out by Clausen for distinguishing this species from *tenuicornis* (Ashmead) will also distinguish it from *cyniformis* (Rossi). The absence of a conspicuous fuscous cloud below the stigmal vein will also help to distinguish the species.

The statements "face with fine longitudinal striations, the front smooth" in the original description appear to me to be inaccurate. Actually that part of the head below the antennae is nearly smooth, without any striations but with obscure suberased punctures except on the clypeus, which is perfectly smooth, while the frons between the scrobe and eye margins is longitudinally rugose. The head viewed from in front is only about twice as broad as long. The ocelli are very nearly in a straight line.

Genus ORASEMA Cameron

This genus was originally described from Panama with *Orasema stramineipes* Cameron as the genotype. The genus apparently is confined to North and South America, the West Indies, and the Australian region.

Specific characters consist for the most part of slight differences in sculpture, which are hard to define. Color of the legs and antennal scape and to some extent the degree of metallic coloration of the body seem to be significant but must be used with caution.

Because of inadequate descriptions and lack of material, the following 11 described species have been omitted from the key to species: *O. festiva* (Fabricius) from Central America; *maculata* (Westwood) and *rapo* (Walker) from Brazil; *argentina* and *doellojuradoi* Gemignani from Argentina; *costaricensis* and *sixaloae* Wheeler and Wheeler from Costa Rica, and *emma*, *gemma*, *palgravei*, and *pheidolophaga* Girault from Australia.

KEY TO SOME SPECIES OF ORASEMA

1. Females----- 2
Males----- 20
2. Abdominal petiole nearly twice as broad as long; prescutum anteriorly broadly impressed in middle----- *texana*, new species
Abdominal petiole at least as long as broad; prescutum without a median impression anteriorly----- 3
3. Axillae and scapulae dorsally nearly smooth and polished, never more than weakly lineolated; mesosternum also mostly smooth----- *coloradensis* Wheeler
Axillae and scapulae densely rugulose or punctate, never polished; mesosternum usually strongly sculptured----- 4
4. Thorax dorsally with coarse irregular rugose sculpture, never with nearly uniform rounded areas or shallow punctures, not alveolate----- 5
Thorax usually with nearly uniform dense shallow rounded punctures dorsally, resembling honeycomb, hence alveolately sculptured; if not alveolate then sculpture is not coarse but finely rugulose----- 8
5. Mesoscutum coarsely transversely shagreened, the parapsides smoother; parapsidal grooves coarsely foveolate, scutellum coarsely longitudinally shagreened and with partial longitudinal striation; petiole longitudinally striate (from original description)----- *cameroni* Howard
Sculpture not as above----- 6
6. Antennal flagellum distinctly thicker than pedicel; all femora dark fuscous or metallic; head mostly metallic green; dorsum of thorax green or if somewhat aeneous the postmarginal vein is very poorly developed and scarcely longer than stigmal vein----- 7
Antennal flagellum not thicker than pedicel; all femora pale; head and dorsum of thorax uniformly aeneous, only the pleura, propodeum, and coxae more or less tinged with green; postmarginal vein well developed and half as long as marginal.----- *aenea*, new species
7. Supraclypeal area nearly twice as long as broad and separated from clypeus by only a broad shallow depression; ocellular line a little longer than distance between posterior ocelli; cheek fully as long as eye and with a broad shallow depression running from eye to base of mandible; scapulae adjacent to parapsidal grooves transversely rugose; scape and tegulae metallic----- *tolteca* Mann
Supraclypeal area subquadrate, cut off from clypeus by a deep furrow; ocellular line distinctly shorter than distance between the posterior ocelli; cheek hardly as long as eye and

- without a pronounced depression; scapulae not transversely rugose; scape and tegulae reddish----- violacea Ashmead
8. Length nearly 5 mm.; antennal groove dilated suddenly at bottom; pleura with the lower and posterior portion striated; coxae closely sculptured (from original description only).
stramineipes Cameron
- Less than 5 mm. in length and not agreeing otherwise with above description----- 9
9. Thorax very finely and irregularly rugulose, not distinctly alveolately sculptured; hindcoxae very nearly smooth and testaceous or fuscotestaceous; scutellum without lateral grooves ----- 10
- Thorax with distinctly alveolate sculpture; hindcoxae metallic and distinctly sculptured at least dorsally; scutellum with more or less distinct lateral grooves----- 11
10. Face very nearly smooth; propodeum more weakly sculptured than scutellum and with a delicate median longitudinal carina.
minutissima Howard
- Face distinctly sculptured, only the clypeus sometimes nearly smooth; propodeum more coarsely sculptured than scutellum and without median carina----- smithi Howard
11. Scutellum with a broad shallow depression down middle and with lateral grooves broad, strongly foveated, and nearly dorsal; transverse furrow on scutellum also broad and strongly foveated; abdominal petiole at least as long as hindcoxae ----- 12
- Scutellum without a median depression and with lateral grooves less prominent and lower down on sides of scutellum; transverse furrow on scutellum either weak or strong; abdominal petiole usually shorter but occasionally as long as hindcoxae----- 14
12. All femora on basal half or more metallic or strongly infuscated; propodeum with nearly uniform alveolate sculpture overlaid medially with some irregular rugulae; supraclypeal area as long as broad and equaling or slightly exceeding clypeus in length----- beameri, new species
- All femora pale testaceous; propodeum in part alveolately sculptured but medially with a somewhat irregular median carina separating two rows of shallow pits or foveae; supraclypeal area a little shorter than clypeus and a little broader than long----- 18
18. Pits on propodeum large; general color bright brassy green; abdomen including petiole brassy green----- aureoviridis, new species
- Pits on propodeum smaller; general color olive-green with the propodeum, more or less of pleura, and sutures on dorsum of thorax purplish; abdomen including petiole purplish black, gaster with strong violaceous tints-----, simulatrix, new species
14. All femora testaceous or pale yellowish----- 15
- All femora metallic or at least distinctly infuscated----- 16
15. Abdominal petiole very slightly longer than broad, distinctly shorter than hindcoxae; mesepimeron smooth and shining on its upper half----- neomexicana, new species

- Abdominal petiole very nearly twice as long as broad and very nearly as long as hindcoxae; mesepimeron wholly opaquely sculptured..... *robertsoni*, new species
16. Supraclypeal area at least as broad as long; clypeal foveae unusually large and deep; abdominal petiole about as broad as long, evenly sculptured dorsally and dark bluish in color.
..... *bakeri*, new species
- Supraclypeal area at least a little longer than broad; clypeal foveae relatively smaller and much shallower; abdominal petiole usually, but not always, distinctly longer than broad, often somewhat irregularly sculptured and usually more or less metallic green..... 17
17. Stigmal vein subquadrate or not much longer than broad..... 18
Stigmal vein more slender and two or three times as long as broad..... 19
18. Abdominal petiole only a little longer than broad; scapulae obviously more weakly sculptured and more shining than the prescutum; general color blackish aeneous to dark green; scape reddish testaceous..... *cockerelli*, new species
- Abdominal petiole nearly twice as long as broad; scapulae only very slightly more weakly sculptured than prescutum; general color bright metallic green; scape more or less metallic... *viridis* Ashmead
19. Color usually bright metallic green tinged with blue or purple, but occasionally more or less aeneous..... *wheeleri* Wheeler
Dull dark green, almost black with a slight greenish tinge.
..... *occidentalis* Ashmead
20. Abdominal petiole longer than posterior femur; scutellum with a median depression..... 26
Abdominal petiole shorter than posterior femur; scutellum without a median depression..... 21
21. Abdominal petiole barely longer than hindcoxa and with some distinct longitudinal rugae..... 22
Abdominal petiole distinctly longer than hindcoxa and without distinct longitudinal rugae..... 23
22. Axillae and scapulae smooth or very weakly sculptured and shining; general color metallic green..... *coloradensis* Wheeler
Axillae and scapulae strongly sculptured and mat; general color dark aeneous..... *minuta* Ashmead
23. Abdominal petiole very nearly or quite twice as long as posterior coxa; clypeal fovea unusually large and deep..... *bakeri*, new species
Abdominal petiole not over one and one-half times as long as posterior coxa..... 24
24. Stigmal vein slender and two and one-half to three times as long as broad..... *wheeleri* Wheeler
Stigmal vein broader and shorter..... 25
25. Color dark green strongly tinged with aeneous..... *cockerelli*, new species
Color bright bluish green tinged with purplish on coxae and abdomen..... *viridis* Ashmead
26. Bright golden green; propodeum medially coarsely pitted and with an irregular median carina..... *aureoviridis*, new species
Dark green with a strong aeneous tinge; propodeum finely alveolate with a few irregular rugae medially but without coarse pits..... *beameri*, new species

ORASEMA TEXANA, new species

This species is distinguishable at once from all others known to me by having the abdominal petiole very nearly twice as broad as long and by having the middle lobe of the mesoscutum anteriorly broadly impressed medially.

Female.—Length 2.9 mm. Head dark metallic green; thorax blackish with rather strong metallic tints on the dorsum; abdomen, except the petiole, brownish black with strong metallic green and bronzy reflections; scape and pedicel pale yellow; flagellum brownish black; coxae concolorous with the thorax; femora all fuscometallic on basal two-thirds; trochanters, apices of femora, all tibiae, and all tarsi pale yellow; wings hyaline, venation yellow. Abdominal petiole, propodeum, and pleura dull blackish with only a very slight metallic tinge.

Head alveolately punctate, the alveolae irregular in shape and size and on the frons more or less elongate; middle lobe of mesoscutum sculptured about like the head; scapulae more weakly and finely reticulated than the prescutum and each with a shallow impression near the inner posterior angle; parapsidal grooves very deep and distinctly foveated; scutellum irregularly rugulose, with a shallow depression medially a little in front of the transverse fold, the transverse fold strong and not distinctly foveated, the lateral grooves very weak and inconspicuous; axillae higher than the scutellum and rugulosely sculptured, not alveolate; metanotum rugose; propodeum very finely and rather evenly reticulately sculptured and with a weak median carina, the spiracular grooves complete and weakly foveolated; pleura finely and nearly uniformly punctate; abdominal petiole and hindcoxae finely sculptured; gaster of abdomen smooth and about as large as the thorax; second sternite faintly granulose. Dorsal valve of ovipositor with nine distinct teeth.

Antennal scape cylindrical, slightly thickened throughout its length, not attaining front ocellus; pedicel globose; flagellum not clavate, very slightly thicker than pedicel; ring joint distinct but strongly transverse; first funicle joint about one and one-half times as long as broad, following funicle joints subquadrate; club three-jointed, not thicker than funicle and a little longer than two preceding joints. Clypeus nearly twice as broad as long, weakly rugulose, its anterior margin not straight but slightly convex; clypeal foveae deep and joined by a distinct groove; supraclypeal area well defined, nearly twice as broad as long, weakly rugulose, a shining smooth area medially; cheeks a little shorter than eyes; ocellocular line about one and one-half times as long as the diameter of lateral ocellus and distinctly shorter than distance between posterior ocelli.

Forewings approximately two and one-half times as long as broad,

nearly bare basally and with a bare area on the middle of disk behind the basal half of marginal vein; costal cell very sparsely ciliated; stigmal vein about two and one-half times as long as broad, slightly oblique; postmarginal vein weak and distinctly less than half as long as marginal.

Type locality.—Denison, Tex.

Type.—U.S.N.M. No. 53552.

Described from 1 female collected in sweeping by L. D. Christenson, August 26, 1937.

ORASEMA COLORADENSIS Wheeler

Orasema coloradensis (Ashmead) WHEELER, Bull. Amer. Mus. Nat. Hist., vol. 23, p. 12, 1907.

Orasema coloradensis, a manuscript name of Ashmead, was first published by W. M. Wheeler, who gave a figure and a short description of the species. The name should therefore be credited to Wheeler and not to Ashmead.

According to Wheeler, specimens were taken at Manitou, Broadmoor, and Colorado Springs, Colo. In the U. S. National Museum collection are three specimens from Colorado, one of which bears the name label in Ashmead's handwriting, and this specimen had been entered in the type catalog as the type of the species. It cannot be the type, however, since it, as well as two other Colorado specimens in the collection, named by Ashmead, was collected by C. F. Baker, and there is no evidence to indicate that it was ever seen by Wheeler. There are apparently no Wheeler collected specimens of the species in the National Museum, hence no type material. The Baker specimens are believed to be the same species, however, and the following descriptive notes on the species are taken from them.

This brilliantly metallic-green species with testaceous scape, tegulae, tibiae, and tarsi is rather easily recognized because of the unusually weakly sculptured dorsum of the thorax. The axillae dorsally, the scapulae dorsally, the posterior portion of prescutum, and to a large extent the dorsum of scutellum are smooth or only very weakly sculptured, usually shining, and often highly metallic green. The prescutum anteriorly, scapulae laterally, axillae on the sides, and the base and sides of scutellum are finely and irregularly rugulose. The parapsidal grooves, sutures between axillae and scutellum, and the transverse furrow on scutellum are deep and distinctly foveated.

The female has the head nearly uniformly rugulose and highly metallic green, wider than the thorax. The postocellar line is longer than the ocellocular line, the latter about equal to twice the diameter of a lateral ocellus. The malar space is a little shorter than the eye, flattened but not depressed down the middle. The clypeus is broader than long, its anterior margin nearly straight. The supraclypeal area

is quadrate or a little broader than long, well defined, the clypeal suture complete and the clypeal fovea rather broad and deep. The antennal scape is subcylindrical, rather short and slightly thicker than usual; the pedicel is about as long as broad, the ring joint is transverse, the first funicle joint is about one and one-half times as long as broad and the following joints of funicle are subquadrate. The club is 3-jointed, no thicker than the funicle and somewhat longer than the two preceding joints. The pronotum behind the head is practically smooth, while laterally it is weakly rugulose. The pleura are rugulose sculptured but the mesosternum, posteriorly at least, is polished. The propodeum is rather strongly rugulose, without carinae but frequently with some more prominent rugae medially which at times may suggest a median carina. The coxae are weakly sculptured, almost smooth. The abdominal petiole is a little shorter than the posterior coxae, about one and one-half times as long as broad and rugosely sculptured. The gaster is smooth and polished. The forewing is rather densely ciliated, sparsely but distinctly so basally, the costal cell nearly uniformly ciliated.

The male is like the female except that the funicle joints are usually somewhat longer, the lateral ocelli are not quite twice their own diameters from the eye margins, the abdominal petiole is a little longer than the hindcoxae, approximately three times as long as broad, and the gaster is much smaller than in the female.

Remarks.—No information is available regarding the three specimens already mentioned as having been identified by Ashmead. They bear labels exactly similar to those used on all Baker's Colorado material and reading "Colo. 799" and "Colo. 778." In Baker's notebook entries under these numbers refer to Lepidoptera and Coleoptera collected in Michigan and Ohio. It is impossible therefore to trace the history of these specimens.

Twenty-one additional specimens of the species found unidentified in the Baker collection were all collected in the neighborhood of Fort Collins, Colo., and 3 specimens from the same collection were taken at Opelousas, La. Other specimens studied include: 1 taken on *Bige-
lov*ia at Albuquerque, N. Mex., August 16, 1895, by T. D. A. Cockerell; 1 from Wades and 2 from San Diego, Tex., taken by E. A. Schwarz; 1 from Cimarron, Kans.; 1 from Beloit, Iowa, collected by G. O. Henderson, July 25, 1928; 46 swept by J. C. Bridwell from *Stylosanthus* at Barcroft, Va., July 5, 1931; 6 taken at Bladensburg, Md.; and 1 collected by Ashmead in eastern Florida.

The specimens from the Eastern States are very slightly smaller and not quite so brilliantly metallic as those from the Western, the dorsum of the thorax usually appearing very slightly more distinctly sculptured. At most these differences seem to be of not more than varietal significance.

ORASEMA CAMERONI Howard

Orasema cameroni HOWARD, Journ. Linn. Soc. London, Zool., vol. 26 (1896), p. 133, 1897.

No representative of this West Indian species has been studied, and it is placed in the key entirely on the basis of the original description.

ORASEMA AENEA, new species

Female.—Length 3.75 mm. Head and thorax strongly aeneous; pleura, propodeum, and all coxae more or less metallic green mixed with cupreous; abdomen varying from mostly fuscotestaceous with a metallic tinge to mostly metallic green, usually more or less brownish testaceous basally becoming darker toward apex, but occasionally almost entirely metallic green; mandibles, scape, pedicel, tegulae, and legs, except their coxae, testaceous; antennal flagellum black; eyes and ocelli reddish; wings hyaline, venation brownish testaceous.

Head and thorax strongly sculptured, the vertex, mesoscutum, axillae and scutellum rugoso-punctate without any alveolate punctures; punctuation of head below vertex, mesopleura, and coxae finer and more or less alveolate; metanotum rugose; propodeum medially and along its anterior and posterior margins rugose, the remainder of its surface, except in the rather broad and deep spiracular grooves, finely alveolately sculptured; abdominal petiole rugoso-punctate and usually with about three longitudinal rugae medially; gaster entirely polished.

Antenna long and slender, not clavate; scape not quite attaining anterior ocellus; pedicel about as broad as long; ring joint transverse; flagellum not thicker than pedicel, its joints all longer than broad, the first joint about twice as long as broad, the second subequal to first, and the following joints successively decreasing slightly in length.

Head, viewed from in front, broader than long; malar space subequal to the height of eye, with a shallow longitudinal depression; clypeus broader than long, uniformly sculptured, clypeal foveae deep; supraclypeal area a little longer than broad, about as long as clypeus and similarly sculptured; ocellocular line shorter than postocellar line; lateral ocellus about twice its diameter from eye margin. Scutellum with a shallow depression medially, without distinct grooves on the sides and with the transverse fold often obscured by the rough sculpture; mesepimeron with its dorsal half, except for a small area on its lower margin, sculptured like the lower half.

Forewing behind submarginal vein not entirely bare; costal cell with numerous nearly uniformly distributed cilia; stigmal vein longer than broad; postmarginal vein fully half as long as marginal.

Abdominal petiole about one and one-fourth times as long as broad, distinctly shorter than hindcoxa.

Male.—Unknown.

Type locality.—Loreto Experiment Station, Misiones, Argentina.

Type.—U.S.N.M. No. 53553.

Described from 15 female specimens received from A. A. Ogloblin and said to have been taken ovipositing in young leaves of *Ilex paraguariensis* ("Yerba mate").

ORASEMA TOLTECA Mann

Orasema tolteca MANN, *Psyche*, vol. 21, p. 183, 1914.

This unusually large species, the type of which measures over 4 mm. in length, is metallic green in color with the head mostly metallic green with a strong aeneous tinge on frons and face, the thorax metallic green but strongly aeneous dorsally as well as on the pleura, the coxae green, the femora dark metallic except apically, and the abdomen polished bluish green. The antennal scape is metallic and the flagellum black. The tegulae are metallic green. The legs except their femora are reddish testaceous, and the wings hyaline.

The sculpture of frons and face is distinctly alveolate while that of vertex, occiput, and temples is more irregular. The clypeus is practically smooth and polished, its anterior margin straight. The supra-clypeal area is nearly twice as long as broad, indistinctly separated from the clypeus by a depression but not a furrow, its surface distinctly sculptured but more weakly so than the frons. The malar space is a little longer than the height of the eye, and there is a broad shallow depression extending from the eye margin to the base of mandible. The ocellocular line is distinctly a little longer than the distance between the posterior ocelli. The antennal flagellum is distinctly thicker than the short pedicel, not thicker apically than basally, its first segment about twice as long as broad, the following segments successively decreasing slightly in length, the last three subequal and each about as long as broad. The mesoscutum is strongly rugoso-punctate, the parapsidal grooves deep and foveolate, and the scapulae along their inner margins transversely striated. The scutellum and axillae are rugoso-punctate, the scutellum with a broad shallow depression medially and with a distinct transverse fold before the apex but without distinct lateral grooves. The propodeum is longer than the hind coxae, nearly uniformly rugoso-punctate, but with a shallow depression along its anterior margin, this depression divided by a short longitudinal carina on the median line and crossed by numerous more or less longitudinally directed rugae. The mesepimeron is sculptured on its upper half as well as on the lower half. The abdominal petiole, viewed from above, is about twice as broad as long, as long as hind coxa, margined by a longitudinal carina on each side, and very weakly sculptured dorsally. The gaster is rather large, smooth and polished. The second sternite is polished with its apical suture foveated.

Male.—Not seen.

Remarks.—Redescribed from the type, a female from San Miguel, Hidalgo, Mexico, in the collection of Dr. W. M. Mann. According to the original description the type was taken in a nest of *Pheidole vasliti* var. *acolhua* Wheeler. A single female from the C. F. Baker collection agrees with the above description except that it is somewhat smaller and nearly uniformly bright metallic green in color with only a very slight aeneous tinge on dorsum of thorax. Baker's notebook shows this specimen to have been swept from alfalfa at Tucson, Ariz., April 11, 1896, by Dr. R. C. Kinze.

ORASEMA VIOLACEA Ashmead

Orasema violacea ASHMEAD, Ent. Amer., vol. 3, p. 187, 1888.

This species is strongly and irregularly rugose, without any alveolate areas. The head is a little broader than the thorax, nearly uniformly rugosely sculptured, concave posteriorly, with the temples strongly receding. The lateral ocelli are a little less than twice their own diameter from the eye margin and a little farther from each other than from the eye.

Eyes obviously a little longer than malar space, the latter without a longitudinal depression; clypeus broader than long, uniformly rugulose, its anterior margin straight; supraclypeal area fully as broad as long, sculptured like clypeus and separated from it by a deep transverse groove; clypeal foveae deep. Antennal scape a little thickened, subcylindrical, not reaching to level of front ocellus; pedicel nearly globular; funicle joints a little thicker than pedicel, the first joint about twice as long as broad, second about two-thirds as long as first, following funicle joints subquadrate; club obscurely 3-jointed and a little longer than last two funicle joints. Pronotum behind head weakly rugulose; remainder of thorax laterally as well as dorsally strongly sculptured, the prescutum and scapulae posteriorly, axillae dorsally and scutellum in front of cross furrow more coarsely rugose than elsewhere; scutellum behind the cross furrow strongly sculptured but not quite so strongly as before it; propodeum nearly uniformly rugoso-punctate, without lateral folds and without a median carina, the spiracular sulci complete. Forewing sparsely ciliated basally, closely ciliated beyond apex of submarginal vein; stigmal vein a little longer than broad; postmarginal vein more slender than marginal and approximately one-half as long as marginal. Abdominal petiole about as long as hind coxae, about one and one-half times as long as broad, rugosely sculptured; gaster smaller than thorax, mostly smooth but the basal segment (second segment of abdomen) weakly rugulose over a large part of its dorsum; second sternite apparently smooth.

Head, thorax, and propodeum green, the frons and face laterally strongly tinted with purplish; scape brownish testaceous, flagellum blackish; coxae concolorous with thorax; all femora dark brown with strong metallic-green reflections; tibiae and tarsi testaceous; abdominal petiole dark greenish; gaster strongly violaceous with the basal segment bright metallic green above; wings hyaline.

Redescribed from the type, a female from eastern Florida.

ORASEMA STRAMINEIPES Cameron

Orasema stramineipes CAMERON, *Biologia Centrali-Americana*, vol. 1, p. 105, pl. 6, figs. 18, a, b, c, d, e, 1884.

Orasema flavipes CAMERON, *Biologia Centrali-Americana*, vol. 1, pl. 5, figs. 20, a, b, c, 1884.

In the description of *stramineipes* Cameron refers to figures on plates 5 and 6. On plate 5 the figures cited are referred to the name *flavipes*, while those on plate 6 are referred to *stramineipes*. The name *flavipes* is evidently a *lapsus calami* and should be considered a synonym of *stramineipes*.

This species, which is the genotype, was originally described from Panama. It is not represented in the National Museum collection and is placed in the key solely on the basis of the original description.

ORASEMA MINUTISSIMA Howard

Orasema minutissima HOWARD, *Journ. Linn. Soc. London, Zool.*, vol. 25, p. 84, 1894.

This unusually small species has the head and thorax bluish green, this color on face and underside of thorax more or less diluted with testaceous. The abdomen is blackish, also diluted with testaceous and with a slight metallic tinge in some lights. The antennae, tegulae, and all the legs, including their coxae, are testaceous, the flagellum of antennae and the coxae sometimes more or less fuscous. The wings are hyaline.

The sculpture of head and thorax is comparatively weak, consisting of shallow more or less irregularly shaped areas, which are not quite uniform in size and shape and hence not so distinctly alveolate as in most of the following species. The scutellum has the transverse fold very weak or subobsolete, and the usual lateral grooves are absent. The propodeum is weakly sculptured and has a very delicate median longitudinal carina. The coxae are practically sculptureless. The abdominal petiole is about as long as the hind coxae and weakly sculptured. The stigmal vein is barely longer than broad and the postmarginal fully half as long as marginal.

Four female paratypes of this species from the island of St. Vincent are in the collection of the U. S. National Museum. There are also two females taken at Mina Carlota, in the Trinidad Mountains

of Cuba, in the same collection. The latter specimens were collected in association with *Wasmannia auropunctata* Roget by W. M. Mann in 1917.

ORASEMA SMITHI Howard

Orasema smithi HOWARD, Journ. Linn. Soc. London, Zool., vol. 26 (1896), p. 134, 1897.

Seven specimens believed to be this species were taken by C. P. Clausen in July 1931 at Hoyo Colorado, Cuba, and bear his note number 2452. One specimen of the same species is in the National collection, taken on the island of St. Vincent, West Indies, by H. H. Smith, and one other specimen that appears to be identical was collected at Virginia Beach, Va., by E. S. G. Titus. The type of the species, which was from the island of Grenada, is in the British Museum and has not been seen, this identification being based entirely upon the description.

The sculpture of the thorax in this species is a mixture of alveolate punctures and fine irregular rugulae, which gives to the surface a somewhat less distinctly alveolate appearance than have the following species. The clypeus is more weakly sculptured than the rest of face, somewhat shining, and its anterior margin is not straight but slightly convex. The flagellar joints are all longer than broad and not thicker than the pedicel. The scutellum in most of the specimens has a very slight depression medially and in all of them the usual longitudinal grooves on the sides are absent. The transverse fold on scutellum is present but weak. The dorsal half of mesepimeron is smooth. The abdominal petiole is more than twice as long as broad and about as long as the hind coxa. The stigmal vein is longer than broad, the postmarginal less than half as long as the marginal, and the costal cell is about as strongly ciliated as is the disk of the wing.

ORASEMA BEAMERI, new species

Female.—Length 2.75 mm. Agreeing with the description of *aureoviridis* except in the following particulars: A little duller metallic green, with the strong brassy tints more uniform on head and thorax; basal half to two-thirds of all femora dark fuscous with a metallic-green tint; apical tergite polished; flagellum very little thicker toward apex than at base; clypeus nearly uniformly finely sculptured, usually not entirely smooth anteriorly; supraclypeal area a little longer than broad, as long as clypeus; propodeum usually with some irregular rugae medially overlying the alveolate sculpture but without a median carina or, if with a semblance of one, this is not flanked by rows of pits or foveae; costal cell with about 20 to 25 discal cilia; postmarginal vein more than twice as long as stigmal vein.

Male.—Length 2.3 mm. Agreeing with the description of the male of *aureoviridis* except that the scutellum is somewhat less strongly sculptured, the axillae and scapulae are also more uniformly finely alveolate, the abdominal petiole is nearly three times as long as hind coxa, the antennal scape and the pedicel are dark metallic, and all of the femora are metallic with their apices narrowly testaceous. The supraclypeal area is usually a little longer than broad as in the female.

Type locality.—Ridgway, Colo.

Type.—U.S.N.M. No. 53554.

Described from 16 females and 7 males collected in the type locality by R. H. Beamer, July 1, 1937. The holotype, allotype, and 10 paratypes are retained in the U. S. National Museum collection. Eleven paratypes, including representatives of both sexes, are being returned to the University of Kansas collection. The species is named for the collector.

ORASEMA AUREOVIRIDIS, new species

This species differs from most other species of the genus known to me by having on the propodeum two longitudinal rows of large, shallow foveae that are separated by a more or less sinuate median longitudinal carina. The scutellum dorsally is unusually strongly margined on each side by coarsely foveated and broad longitudinal grooves, which extend from the base of the scutellum to the transverse fold or furrow, which is likewise unusually strongly developed, and there is also a shallow depression down the middle of the scutellum. The antennal flagellum is more distinctly clavate than usual and the funicle joints, except the first and second, are broader than long.

Female.—Length 3 mm. Bright metallic green with brassy tints; flagellum black; scape, pedicel, mandibles, tegulae, and all legs except their coxae pale testaceous; wings hyaline, venation yellowish.

Head and thorax with nearly uniform, strong, alveolate punctation; parapsidal grooves and sutures at base of scutellum coarsely foveated and median depression on scutellum usually with a few irregularly transverse rugae; coxae distinctly sculptured but more weakly so than thorax; abdominal petiole with fine alveolate punctation; second sternite as well as the rest of gaster polished; apical tergite faintly reticulately sculptured.

Antenna rather short; scape cylindrical, not reaching to level of anterior ocellus; pedicel a little longer than broad; ring joint strongly transverse; flagellum slightly increasing in thickness from base to near apex; first joint of funicle about one and one-half times as long as broad and about as broad as pedicel, second joint subquadrate, third

joint a little broader than long, fourth and following joints shorter, the seventh about twice as broad as long; club indistinctly 3-jointed and a little longer than two preceding funicle joints. Head strongly transverse; occiput broadly but not deeply concave; ocelli in an obtuse triangle; postocellar line a little longer than ocellocular line; lateral ocellus about twice its own diameter from eye margin; eyes bare; malar space about equal to the eye in length, with a distinct broad, shallow depression running from eye to base of mandible; clypeus broader than long, less strongly punctate than rest of face, quite smooth anteriorly, its anterior margin straight; clypeal foveae and sutures deep; supraclypeal area defined by deep lateral grooves, a little broader than long, shorter than clypeus, and sculptured about like base of clypeus. Thorax moderately robust; scutellum at apex protruding over the metanotum; propodeum slightly shorter than scutellum basad of the transverse fold, strongly alveolately punctate over its whole surface, without lateral folds but with deep and strongly foveated spiracular sulci and more or less strongly foveated along its basal margin, the middle of propodeum slightly flattened or depressed and divided by a sinuate median longitudinal carina from which originate several irregularly transverse rugae to form, on each side of the carina, a series of rather large shallow irregularly shaped areas or foveae. Legs moderately stout, the anterior femora a little swollen; posterior tibiae each with two distinct spurs, the inner spurs the longest. Forewing rather weakly ciliated, bare basally, the costal cell with only four or five cilia; marginal vein a little more than half as long as submarginal, stigmal vein short, a little curved at apex, postmarginal about twice as long as stigmal. Abdominal petiole a little longer than posterior coxae, evenly and rather finely alveolate, without any rugae; ventral margin of gaster a little longer than petiole; dorsal segments not emarginate.

Male.—Length 2.5 mm. Antennae short, the flagellum thick; first funicle joint not longer than broad, following joints all distinctly broader than long; scutellum rugulose, the alveolate sculpture largely replaced by irregular rugae; scapulae anteriorly and axillae dorsally also irregularly rugulose; abdominal petiole about two and one-half times as long as hind coxae; much longer than ventral margin of gaster, the gaster much smaller than in female; pedicel of antenna and posterior femora more or less metallic. Otherwise like the female.

Type locality.—Uvalde, Tex.

Type.—U.S.N.M. No. 53555.

Two females (1 holotype) and 2 males collected by A. W. Lindquist, May 2 to 22, 1933, under Bishopp No. 20031.

ORASEMA SIMULATRIX, new species

Female.—Length 3.5 mm. Apparently agrees in every respect with the description of *aureoviridis* except in the following particulars: Antennae very slightly less distinctly clavate; propodeum more evenly alveolately punctured, less distinctly flattened medially, with the pits or foveae on each side of the median carina much smaller; costal cell of forewing with approximately 20 weak discal cilia; color of head and thorax dull dark green, without conspicuous brassy tints; propodeum dull blackish with a distinct purplish tinge; pleura in part, apex of scutellum and the thoracic sutures tinged with purplish; gaster purplish black with an aeneous tinge, its first segment (second tergite) mostly metallic green; coxae green; femora, tibiae, and tarsi yellowish testaceous as are also the mandibles, scape, pedicel, and tegulae; flagellum blackish brown; wings hyaline.

Type locality.—Oracle, Ariz.

Type.—U.S.N.M. No. 53556.

Described from 1 female specimen collected by Hubbard and Schwarz at Oracle, Ariz., July 14, 1898.

ORASEMA NEOMEXICANA, new species

Female.—Length 2.6 mm. Differs from the description of *robertsoni*, besides in the smaller size, by having the abdominal petiole very little, if any, longer than broad, the postocellar line obviously longer than the ocellocular line, the lateral ocellus about twice its own diameter from the eye margin, none of the flagellar joints except the first longer than broad, the supraclypeal area polished medially and separated from clypeus by a shallow but distinct groove connecting the clypeal foveae, the upper half of mesepimeron smooth, the scutellum a little less convex dorsally and with its lateral carinae not quite so far below the dorsum. The color is as in *robertsoni* except that the mesoscutum and scutellum are more strongly tinged with coppery and the antennal scape and the femora are not washed with metallic.

Male.—Unknown.

Type locality.—San Augustine Ranch, at eastern base of Organ Mountains, N. Mex.

Type.—U.S.N.M. No. 53557.

Described from 3 females collected by T. D. A. Cockerell and bearing his numbers 2163, 2265, and 2268. Also 1 female taken by Cockerell at Albuquerque, N. Mex., on *Guitierrezia*. A female collected by W. M. Mann at Las Parras, Baja California, in October 1923 seems to agree with the types except that the abdominal petiole is fully one and one-half times as long as broad.

ORASEMA ROBERTSONI, new species

Similar to *viridis* Ashmead but differs by having the femora all testaceous instead of green, the head and thorax dark green instead of bright green, and the mesepimeron completely sculptured instead of smooth on its upper half.

Female.—Length 3.25 mm. Dark olive-green, the mesoscutum and scutellum dorsally faintly aeneous; antennal scape and legs, except coxae, testaceous, the scape and femora slightly washed with metallic; pedicel and flagellum brownish black; coxae and abdominal petiole concolorous with thorax; gaster metallic green; wings hyaline. Head, thorax, propodeum, coxae outwardly, abdominal petiole, and the second sternite with nearly uniform fine alveolate punctation; gaster mostly polished. Antennal scape cylindrical, reaching to level of lower margin of front ocellus; pedicel a little longer than broad; flagellum a little thicker than pedicel, not at all clavate; ring joint very small and inconspicuous; first funicle joint not quite twice as long as broad, following joints successively diminishing slightly in length, the seventh joint subquadrate; club very slightly longer than two preceding joints. Head as wide as thorax, slightly concave behind; ocelli in a low triangle; postocellar line slightly longer than ocellocular; lateral ocellus a little more than twice its own diameter from eye margin; antennal scrobe shallow; malar space very nearly as long as eye, slightly flattened or very weakly depressed for its whole length; clypeus uniformly sculptured but a little less strongly so than the rest of face, about as long as wide at apex, its anterior margin nearly straight; supraclypeal area defined laterally by deep grooves but not distinctly separated from clypeus, the usual suture connecting the clypeal fovea nearly obsolete. Parapsidal grooves deep and weakly foveated; scutellum high, convexly rounded dorsally, weakly margined low down on the sides and with a deep transverse groove before the apex; propodeum with deep and coarsely foveated spiracular sulci and with some small foveae along the basal margin but without lateral folds or median carina. Legs normal. Forewing weakly ciliated, bare basally, the costal cell very nearly or quite bare; marginal vein more than half as long as submarginal; postmarginal vein about one-third as long as marginal, stigmal vein short and slightly oblique. Abdominal petiole as long as hind coxa, about twice as long as broad; gaster a little smaller than thorax, its base beneath (second sternite) sculptured like the petiole and the two apical tergites very weakly shagreened, the rest smooth and polished; ovipositor not exerted.

Male.—Unknown.

Type locality.—Southern Florida.

Type.—U.S.N.M. No. 53558.

Described from 2 female specimens collected by Charles Robertson and bearing his numbers 12716 and 12754, respectively. The specimen bearing No. 12716 is the holotype.

ORASEMA BAKERI, new species

This species is not easily distinguished from *viridis* and *cockerelli*, but it differs from both by having the supraclypeal area as broad as long and the clypeal foveae unusually large and deep. The abdominal petiole is distinctly shorter than in *viridis* and the color is much less distinctly aeneous than in *cockerelli*. The shorter and more evenly sculptured petiole, the larger and deeper clypeal foveae, and slight differences in color and sculpture are all that distinguish it from *wheeleri*.

Female.—Length 3.25 mm. Head and thorax dark green in color with a slight brassy tinge, stronger on the face; scape reddish testaceous, pedicel fuscotestaceous, flagellum brownish black; coxae concolorous with thorax; femora all dark fuscometallic; trochanters, apices of femora more or less, all tibiae, and all tarsi reddish testaceous; tegulae brownish; propodeum and abdominal petiole dark bluish green, sometimes with a purplish tinge; gaster shining dark green; wings hyaline, venation yellowish.

Head with alveolate sculpture, the alveolae on face, frons, and temples irregular in shape and somewhat coarser than on vertex; dorsum of thorax sculptured like the head, the posterior portion of prescutum, the axillae dorsally, and the scutellum dorsally with very fine, nearly round, alveolae; the anterior portion of prescutum and the scapulae with the alveolae more irregular in shape and those on scapulae distinctly shallower than on prescutum; transverse fold on scutellum present but not distinctly foveated, the lateral grooves distinct and weakly foveated; propodeum very finely alveolately punctate, with some foveae along the anterior margin, but without carinae, the spiracular grooves deep and complete and weakly foveated; pleura nearly uniformly finely alveolate, with the prepectoral triangle not sharply margined anteriorly; coxae distinctly sculptured; abdominal petiole about as long as broad and evenly alveolate like propodeum; second sternite as well as rest of gaster smooth.

Head viewed from in front broader than long, about in the proportion of 50 to 40; clypeus distinctly broader than long, its anterior margin very nearly straight; clypeal foveae very broad and deep; supraclypeal area well defined, separated from clypeus by a deep depression connecting the clypeal foveae, at least as broad as long and usually a little broader than long; malar space very nearly as long as eye, flattened but without a distinct longitudinal depression; ocellocular line nearly equal to the distance between posterior ocelli and a little more than twice as long as the long diameter of a lateral

ocellus. Antennal scape cylindrical, not quite reaching the level of lower margin of front ocellus; pedicel as broad as long; ring joint minute; flagellum a little broader than pedicel, not clavate; first funicle joint not quite twice as long as broad, following joints subequal and subquadrate; club indistinctly 3-jointed and a little longer than the two preceding joints combined.

Forewings about two and one-third times as long as broad, bare basally and with a bare area medially behind the marginal vein; costal cell with a few weak cilia; stigmal vein approximately two and one-half times as long as broad and nearly perpendicular to the marginal vein; postmarginal vein less than half as long as marginal.

Male.—Length 2.6 mm. Scape dark, more or less metallic; flagellar joints distinctly thicker than pedicel; seventh funicle joint very slightly broader than long; abdominal pedicel very nearly twice as long as hind coxa. Otherwise like the female except much more slender.

Type locality.—Fort Collins, Colo.

Type.—U.S.N.M. No. 53559.

Described from 10 females and 2 males. The holotype, allotype, and 7 female paratypes bear C. F. Baker collection No. 1563 and according to his notes were taken in miscellaneous sweepings at Fort Collins, Colo., June 13, 1895. One paratype female with Baker No. 1086 was taken at Fort Collins in June on wild-parsnip bloom. One male was taken by Baker at Pagosa Springs, Colo., and a single female was collected by Hubbard and Schwarz at Oracle, Ariz., June 7, 1898.

ORASEMA COCKERELLI, new species

Differs from *wheeleri* by having the stigmal vein shorter and not so slender, by having the abdominal petiole slightly shorter, and by its darker color which, however, varies from aeneous black to distinctly green with an aeneous tinge. From *viridis* it can be separated only by the slightly shorter petiole, the nonmetallic scape, and the somewhat darker color of head and thorax.

Female.—Length 2.4 mm. Aeneous black with a slight greenish tinge; flagellum black; scape, apices of femora more or less, all tibiae, and all tarsi testaceous; abdomen brownish black; wings hyaline, venation and tegulae brownish testaceous. Antenna weakly clavate; scape cylindrical, not quite reaching front ocellus; pedicel about as long as broad; funicle a little thicker than pedicel; first funicle joint nearly twice as long as broad, second very slightly longer than broad, following joints subquadrate, the seventh a little broader than long; club a little longer than two preceding joints, rather sharp at apex. Head alveolately sculptured, the alveolae on frons and face a little compressed; postocellar line longer than ocellocular, lateral ocellus

a little more than twice its own diameter from eye margin; malar space a little shorter than eye; clypeus very finely rugulose, its anterior margin straight; supraclypeal area longer than broad, polished medially below. Thorax alveolately punctate, the sculpture on scapulae a little weaker than on prescutum; parapsidal grooves and sutures at base of scutellum weakly foveated; scutellum without a median depression, the transverse furrow and lateral grooves weakly foveolate; propodeum evenly alveolate, without carinae, the spiracular sulci and posterior margins of propodeum foveated; pleura sculptured like dorsum, except that the upper half of mesepimeron and the metapleura are for the most part smooth. Wings weakly ciliated, bare basally and in the costal cell; stigmal vein short, about as broad as long. Coxae outwardly sculptured like pleura. Abdominal petiole very little longer than broad and finely punctate; gaster' smaller than thorax, smooth; second sternite not seen.

Male.—Length 2.2 mm. More slender than the female; flagellum a little longer, the funicle joints after the first very slightly longer than broad; lateral ocellus not over twice its own diameter from eye margin; abdominal petiole about four times as long as broad, about one and one-half times as long as hindcoxae; gaster much smaller than thorax. Scape metallic; head and thorax strongly tinted with coppery. Otherwise like the female.

Type locality.—Albuquerque, N. Mex.

Type.—U.S.N.M. No. 53560.

Described from 3 females (one holotype) and 5 males (one allotype) collected by T. D. A. Cockerell, August 16, 1895, on *Bigelovia*. Two of these females numbered 4613 and 4614, respectively, and two males numbered 4611 are considerably greener in color than the holotype and allotype but otherwise seem to be the same.

In addition to the above series, the collection contains 2 specimens swept by C. N. Ainslie at Sioux City, Iowa; 1 specimen taken by H. C. Knutson, August 7, 1934, in Iowa (Co. 43); 12 specimens collected by C. F. Baker at Fort Collins, Colo., by miscellaneous sweepings in June 1894 and June 1895; and 1 specimen collected by E. A. Schwarz in the Santa Rita Mountains in Arizona in July (?1898). One female taken at Belen, N. Mex., August 19, 1927, by P. A. Radio, and 1 female from Barton County, Kans., collected by S. G. Hunter were also identified as this species and returned to the University of Kansas. All these specimens may be considered paratypes.

ORASEMA VIRIDIS Ashmead

Orasema viridis ASHMEAD, Proc. California Acad. Sci., vol. 5, p. 553, 1895.

Orasema viridis was originally described from one specimen collected in Tepic, Mexico. The type is believed to have been destroyed

in the San Francisco earthquake and fire. Five specimens in the U. S. National Museum, collected in Pinery Canyon, Chiricahua Mountains, Cochise County, Ariz., July 26, 1919, by Dr. Witmer Stone, seem to agree perfectly with Ashmead's brief description of *viridis* and are taken to be representatives of that species.

The same collection contains two small series of specimens identified by Ashmead as *viridis* that appear to agree with the above-mentioned specimens except that they have a longer and more slender stigmal vein and the scape of the female is usually yellowish instead of metallic. These characters are the only ones by which I am able to separate what I believe to be *viridis* from *wheeleri* Wheeler, and consequently I have transferred both series of specimens to the latter species (see remarks on *wheeleri*).

Orasema viridis, as represented by the five specimens already mentioned, is very similar to *neomexicana*, new species, but is readily distinguished from that species by the metallic-colored femora and scape. It differs from *cockerelli*, new species, by having the petiole of the female more slender and obviously longer than broad, by having the scape metallic, and by its distinct green color. From *occidentalis* Ashmead it can be distinguished by the strongly sculptured second sternite, the shorter stigmal vein, and its brighter green color.

The head, thorax, propodeum, and abdominal petiole are nearly uniformly alveolately punctate with only the clypeus, metapleura, and upper half of mesepimeron somewhat more weakly sculptured. The hindcoxae are sculptured above, smooth beneath. The clypeal margin is very nearly straight and the separation between clypeus and supraclypeal area is indistinct, being merely a broad shallow depression. The scutellum is without a median depression but the transverse groove is distinct as are also the lateral grooves. The wings are hyaline with the stigmal vein about one and one-half times as long as thick and not especially slender, the postmarginal vein weak but distinctly longer than the stigmal and the costal cell is sparsely hairy. The antennal flagellum is a little thicker than the pedicel, its first funicle joint about twice as long as the pedicel and about one and one-half times as long as broad, the following funicle joints subquadrate.

The male is like the female except that the antennae are very slightly longer, the abdominal petiole is about one and one-third times the length of hind coxa and the gaster is smaller.

Besides the 5 specimens from Cochise County, Ariz., there is 1 female in the U. S. National Museum collected in the Huachuca Mountains, Ariz., a gift of the Brooklyn Museum and bearing their catalog number 320.

ORASEMA WHEELERI Wheeler

Orasema wheeleri WHEELER, Bull. Amer. Mus. Nat. Hist., vol. 23, p. 14, 1907.

Orasema viridis WHEELER (not Ashmead), Bull. Amer. Mus. Nat. Hist., vol. 23, pp. 2-12, 1907.

According to Wheeler, a single female that he collected at Fort Davis, Tex., July 14, 1902, in a nest of *Pheidole ceres* Wheeler was submitted to Ashmead for identification. Ashmead identified it as a new species, which he proposed to call *wheeleri* but never published the name. In 1907 Wheeler published a short account of the species in which he compared it with *viridis*, and he is therefore responsible for the name. Wheeler's description consists merely of the following statements: "It measures 2.7 mm. and closely resembles *O. viridis*, especially in the shape of scutellum and epinotum but the thorax is broader and stouter. The last pupal envelope, like that of *viridis*, is without pustules, though it has strong intersegmental welts in the abdominal region."

The U. S. National Museum possesses one female specimen, which according to the labels was taken by W. M. Wheeler at Fort Davis, Tex., June 11, 1902, in the nest of *Pheidole carbonaria* Pergande. This specimen bears the name label in Ashmead's handwriting and is believed to be the specimen referred to by Wheeler despite the discrepancies in the date and host. Wheeler states definitely that only one adult, and that a female, was secured. The discrepancy in date may perhaps be accounted for by assuming that the date on the specimen is that on which it was collected as a pupa, while the date used by Wheeler was the date of appearance of the adult. The difference between the host label and Wheeler's statement regarding the host may represent a revised identification of the host material.

This supposed type specimen seems not to be distinguishable from two small series of specimens identified by Ashmead as *O. viridis* and believed to be representatives of the material upon which Wheeler based his remarks concerning the species *viridis* in the above-cited article. One of these series, comprising seven specimens, labeled simply Austin, Tex., is believed to be the material that Wheeler states was identified for him by Ashmead as *O. viridis* and that formed the basis, in part at least, for his account of the habits of *viridis*. The other series of four specimens is from San Diego, Tex., and is probably the material collected by E. A. Schwarz and erroneously referred to by Wheeler as having been the basis of the original description of *viridis*. The supposed type specimen is less strongly bluish green than most of the specimens constituting the two series referred to, its prescutum, scutellum, and axillae being dull aeneous, but there appear to be no structural differences of any kind, and, since at least one or two of the San Diego specimens are very nearly

identical with the type in color and the whole lot shows a distinct gradation from the one color to the other, I believe they are all one species. The type specimen was collected as a pupa and the adult reared out in the laboratory which may very well account for its somewhat abnormal color.

As thus constituted, *O. wheeleri* is not easily distinguishable from what I believe to be true *viridis* Ashmead. In *wheeleri* the stigmal vein is slender and about two and one-half to three times as long as broad, while in *viridis* it is a little thicker and apparently about one and one-half times as long as broad. In *wheeleri* the scape of the female is pale testaceous, while in *viridis* the scape in both sexes is more or less metallic. These differences are not very striking and apparently subject to some variation so that it is not always easy to decide to which species a given specimen belongs. It is not improbable that future investigations may show that the differences are merely racial or varietal characteristics and not specific characters.

In addition to the material already mentioned, the U. S. National Museum collection contains the following specimens collected at Fort Collins, Colo., by C. F. Baker: 2 specimens under No. 2121 taken on *Eriogonum effusum*, August 12, 1896; 2 specimens under No. 1596 taken on *Eriogonum*, August 12, 1895; 1 specimen under No. 1604, also on *Eriogonum*, August 20, 1895; and 1 specimen under No. 1373, taken in August 1894.

ORASEMA OCCIDENTALIS Ashmead

Orasema occidentalis ASHMEAD, Proc. Ent. Soc. Washington, vol. 2, p. 355, 1892.

I can distinguish this species from *wheeleri* only by the much darker (blackish green) color. The second sternite appears to be smooth and polished instead of more or less distinctly punctate. The abdominal petiole is only very slightly longer than broad. The head and thorax are finely and deeply alveolately punctate, this sculpture on scutellum overlaid with very fine longitudinally directed rugulae.

The material examined comprises only the type, a single female, taken in Los Angeles County, Calif.

ORASEMA MINUTA Ashmead

Orasema minuta ASHMEAD, Ent. Amer., vol. 3, p. 185, 1888.

Orasema minuta was described from one specimen taken at Jacksonville, Fla., and said by Ashmead to have been a male. This type specimen, which is in the U. S. National Museum collection, has lost the gaster, so that it is impossible now to be sure of its sex. The abdominal petiole, which is still intact and which is about as long as the hind coxae, appears rather short when compared to that of other

males, but it is more slender than that of most females, and it therefore appears likely that Ashmead was correct as to the sex of the type.

The antenna is rather long with the funicle joints all longer than broad (missing beyond the sixth funicle joint), slightly broader than the pedicel and more distinctly separated than usual. The clypeus is sculptured about like the rest of the face, its anterior margin slightly convex, the clypeal foveae and lateral sutures rather shallow. The supraclypeal area is separated from the clypeus by a shallow depression, not a suture, and the lateral sutures are also shallow and indistinct. The ocellocular line is about twice as long as the diameter of an ocellus and distinctly shorter than the line between posterior ocelli. The sculpture of head and thorax is alveolate but somewhat irregularly so. The scutellum is rather narrow, much longer than broad, with a distinct transverse groove and weak lateral grooves. The mesepimeron is sculptured on upper half about as on lower half. The propodeum is very finely alveolately sculptured with some weak rugulae medially. The hind coxae are alveolately sculptured dorsally. The abdominal petiole is very slightly longer than the hind-coxae and rugosely sculptured with about four longitudinal rugae. The stigmal vein is longer than broad and the postmarginal is very slightly longer than the stigmal. The color is very nearly black but tinged with bronze on dorsum of thorax. The scape, tibiae, and tarsi are all testaceous, the femora strongly infuscated.

Notes from the type.



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A REVIEW OF THE PARASITIC CRUSTACEA OF THE
GENUS ARGULUS IN THE COLLECTIONS OF THE
UNITED STATES NATIONAL MUSEUM¹

By O. LLOYD MEEHEAN

THE copepods of the family Argulidae, popularly known as fish-lice, are of economic importance in that they cause serious depredations on fish populations of confined environments. Whole pools and lakes have been depopulated as a result of their attacks. On the other hand, under ordinary conditions these animals may be very inconspicuous with their depressed bodies flattened tightly against those of their hosts. They inhabit the gill cavities, the edges of the eyes, the base of the fins, and other tender portions of the fish's body.

Wilson (1902) first brought together the literature and descriptions of American and other species. Since that time he has described a number of species in various periodicals, and many other descriptions of new species have accumulated. At the present time, however, it is with great difficulty that a specimen may be identified unless one is familiar with all the species. Usually it is necessary to have an adult male to be positive of correct identification. Meanwhile, already known species are being redescribed as new because of the meagerness and incompleteness of the original descriptions. It is hoped that by the use of this paper identification may be facilitated, and it is the intention to bring the literature and knowledge of American species together.

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The argulids in the United States National Museum have been examined, as well as some from other sources. In cases where synonymy was suspected, specimens of both species were examined before any decision was made. Dr. Waldo L. Schmitt and Clarence R. Shoemaker, of the staff at the Museum, were more than kind in their efforts to facilitate the completion of the work. The latter was especially helpful in the final preparation of the manuscript. The American Museum of Natural History lent me the type specimen of *Argulus ingens* for study. Dr. C. B. Wilson gave considerable assistance in many ways, including the loan of specimens of *A. japonicus*. Examples of this same species were sent to me from Japan by Dr. T. Tokioka, of the Mitsui Institute of Marine Biology, and by Dr. Watanabe, College of Fisheries, Hakodate, Japan. Dr. A. S. Pearse lent me a number of specimens. The Bass Biological Station at Englewood, Fla., lent me specimens of *A. varians* for comparative purposes, and specimens were received from one or two other sources.

One new species, *Argulus floridensis*, is here described. The types have been deposited in the collections of the National Museum.

MORPHOLOGY

For the purpose of description, it is necessary to designate the appendages by name, but there is some confusion in the literature in regard to the proper nomenclature. It is felt therefore that some premise should be made for the application of the names used here.

Considerable controversy surrounds the occurrence of a pair of appendages in the proboscis. Claus (1875) expressed the view that the other pair of "appendages" in the proboscis were maxillae. Wilson supports him in this. Grobben (1908) made dissections and cross sections of the proboscis and showed that the so-called appendages were really outgrowths of the lower lip and could not be true appendages. Martin (1932) studied the development of the embryo and found no maxillae in the proboscis, but there was a pair of outgrowths on the lower lip with hollow spines on them, which she called labial spines.

In some instances it seems that the true mandibles have been confused with maxillae. Shortly before ecdysis the exoskeleton loosens, leaving the mandible on the inside. In such a case one structure is the exact duplicate of the other. This is common on mature specimens. An examination of cleared and other specimens from a number of species has shown that Grobben and Martin are probably correct, since no maxillae could be found. Labial spines are almost always seen, sometimes projecting from the opening of the buccal cavity.

Martin has shown that the development of the buccal cavity is from the basal segments of the mandibles and the lower and upper lips. Reason indicates that the maxillae would have to develop between the upper and the lower lip in order to be in the proboscis. This would be contrary to maxillary development in other Crustacea where the maxillae lie behind the under lip. On the Caligoidea the first maxillae are near the base and lateral to the second antennae, and the second maxillae are at the sides of the suctorial tube.

Scott and Scott (1913) state that in copepods the various appendages develop in regular order and in the parasitic forms may then degenerate. These appendages include two pairs of maxillae and a pair of maxillipeds. No one has shown in a satisfactory manner that all these ever occur on argulids. On the basis of the above evidence it was decided that the two pairs of appendages between the mandibles and the first swimming legs should be called maxillae, with only the mandibles in the buccal cavity.

Among the argulids the body is depressed, as a result of adaptation to their parasitic existence on the external surface or in the gill cavities of fishes. The carapace (fig. 21, *b*) is composed of lateral lobes or alae, which originate as folds of the posterior region of the cephalon and are fused to the dorsal surface of the first segment of the thorax. Dorsally the cephalon proper is separated from the first thoracic segment by a transverse groove. Extending obliquely from this groove on each side is a ridge, which sets off the cephalic area and more distally extends outward on the carapace as a groove ending at the edge in a slight sinus.

Extending forward from the transverse groove on the middorsal surface of the carapace is a pair of ridges lying close together, the dorsal ridges, which pass between the eyes and end some distance forward. They may either be parallel or bow toward each other just posterior to the eyes and away from each other just ahead of the eyes. A median "nauplius eye" may be seen between the ridges just anterior to a transverse groove or ridge some distance posterior to the compound eyes. On two American fresh-water species the dorsal ridges are branched at the anterior end; others are simple.

The alae extend backward over the thorax, leaving a sinus that exposes the three free thoracic segments between them. These lobes may extend to the third swimming legs or far enough back partially to cover the abdomen. They may partly close the sinus by overlapping slightly, as on some species where the alae extend over the abdomen, or they may flare out leaving the sides of the sinus diverging.

The abdomen is unsegmented and bilobed at the posterior end, forming the anal sinus. The anus is found at the base of this sinus, while somewhere along the inner edges is a pair of anal furcae.

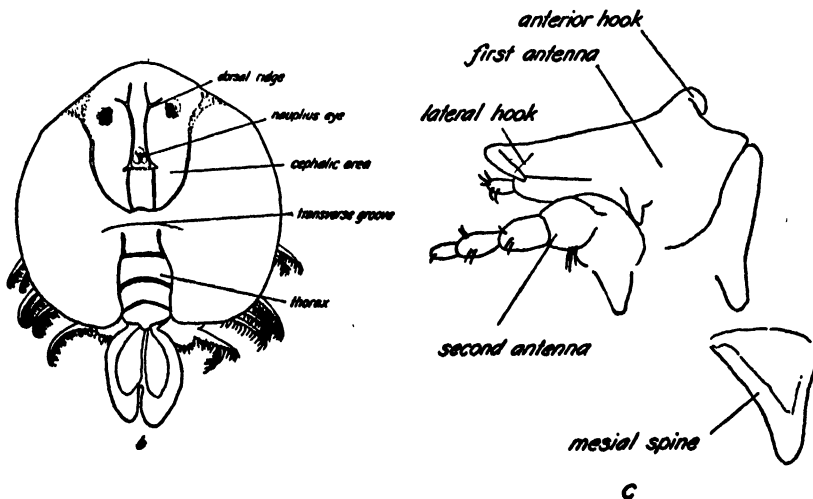
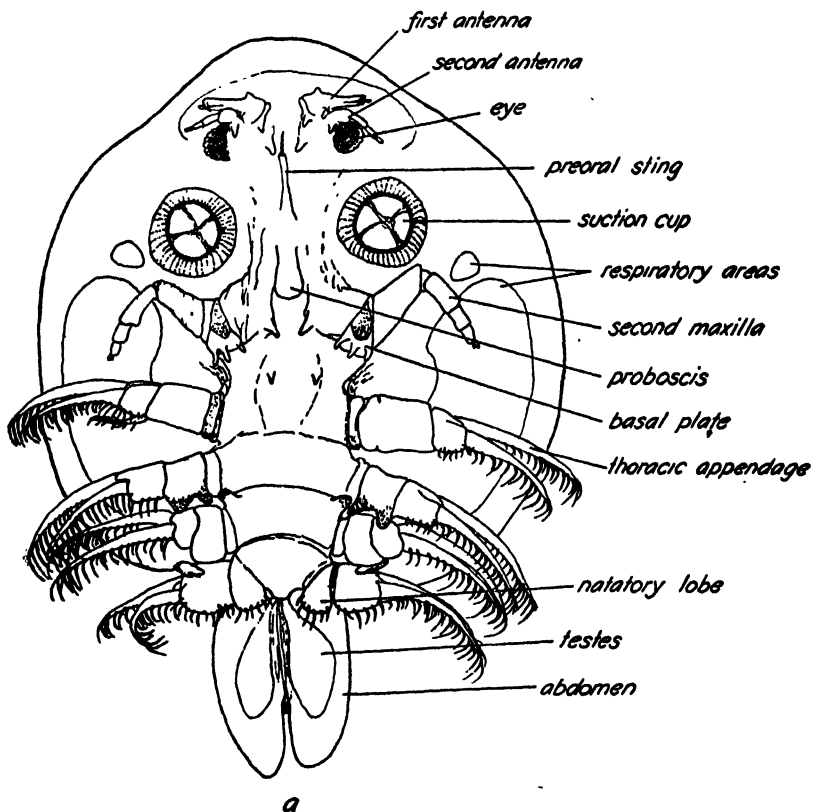


FIGURE 21.—a, *Argulus japonicus*, male, ventral view; b, same, dorsal view; c, antennae of *Argulus pugettensis*.

On the ventral side the various appendages can be seen (fig. 21, *a*). On the anterior end of the body are two pairs of antennae. The first segment of the anterior pair is chitinized, sometimes with a spine at the base. The second segment is enlarged and prolonged into a lateral hook. On the anterior surface of the hook there may be a fingerlike prolongation with or without another anterior hook. In a few instances this may be a mere knob or almost missing. Often there is also a ventral spine on the posterior surface of the hook mesial to the base of the flagellum which extends to about the length of the lateral hook (fig. 21, *c*).

On the second antennae the proximal segments are enlarged, usually with a spine at the base. The distal segments are slenderer and considerably longer than those of the first antennae. Near the midline of the body just posterior to the antennae is another pair of spines, the postantennal spines. All these spines will be used in identification.

According to Martin (1932) the spine sometimes seen on the interior of the lateral hook will become the exoskeleton after ecdysis. The end of the hook is perforated with a gradually widening canal leading back to a chitin-lined sac thrown into many folds with a large number of chitinous hairs. It is probably gustatory in function.

In the longitudinal groove running forward mesially between the antennae is a preoral sting, which is retractile into a sheath and at the base of which is a poison gland. Posterior to this sting is the proboscis, which also lies in the groove when at rest but which is erected at right angles to the body when functioning. It is a cylindrical bulbous structure somewhat larger in size than the sting and carries the true mouth. The framework is of chitinous bars, which enclose the buccal cavity and extend into the proboscis.

The buccal cavity is formed by the delicate upper lip and the more bulbous lower lip. The anterior portion of the buccal cavity contains a pair of swellings ending in hollow spines, the labial spines. They come in contact with the host first. Martin has shown that very early in embryonic life these develop from the lower lip.

The mandibles project from the sides and are completely enclosed by the buccal cavity when at rest. The basal segments of the mandibles assist in the formation of the proboscis in a very early embryonic stage by fusion of the distal portions of the basal segments with the lips. In this way the upper and lower lips form the dorsal and ventral walls, and the mandibles the lateral walls, of the buccal cavity.

The suction cups, or so-called sucking disks, develop from the maxillae on each side of the preoral sting. They have a flat rim covered by a chitinous exoskeleton with thickenings like ribs radiating

outward. These ribs are variously broken up into segments, which are more or less characteristic for a given species. They may be a series of long or short rods (fig. 26, *c*), segments simulating imbricate plates (fig. 27, *a*), or an elongate segment followed by a series of overlapping plates (fig. 22, *b*). The number of plates in the ribs varies only slightly for a given species. They will be used for identification purposes.

The next pair of appendages constitutes the second maxillae. They have a triangular plate on the basal segment, which is divided posteriorly into three teeth or lobes (fig. 26, *a*). The shape of these is more or less constant for the species. On each side of the midline of the body at the base of this appendage is a pair of spines, and posterior to it, just ahead of the first thoracic appendage, is a second pair. These two pairs of postmaxillary spines will be used along with the teeth of the basal plate to aid in identification. These appendages are considered maxillae because they occur ahead of the transverse groove separating the head and thorax and have an excretory gland, the so-called maxillary gland at their base, and because no maxillae are found in the buccal cavity as sometimes stated.

The four pairs of thoracic appendages are made up of a protopod, composed of the precoxa, coxa, and basis, and of two rami, the exopod and endopod. The precoxa is very small in most species, but on a few with long appendages it becomes sizable. The two anterior pairs may have a flagellum extending mesially from its point of origin (fig. 38, *d*) on the dorsal side at the base of the exopod.

On the female the thoracic appendages may be modified by having a slight chitinous ridge armed with setae on the posterior ventral surface of the coxa. Almost every species has a boot-shaped or rounded natatory lobe extending from the posterior of the coxa of the last appendage. On the male it may or may not be the same size and shape as that of the female of the same species.

On the male the second, third, and fourth appendages are modified for copulation. These specific modifications have hitherto been used as practically the only positive means of identification. On the ventral posterior axis of the second appendage is usually found a bilobed prominence extending the full length of the coxa. It may be variously modified or be entirely lacking. This structure is usually covered with chitinous spines, which are very often truncate.

Typically the coxa or basis of the third appendage is modified on posterior surface by the formation of the socket (fig. 32, *c*), the so-called "semen capsule" or "semen pocket" of many authors. This is formed by a fold of tissue from the posterior or ventral side of the appendage turned toward the dorsum to produce a pocket. From the ventral side it appears as a rounded or oblong lobe projecting backward and overlaps the "peg" on the next appendage. From

above, the opening is oblong or round and approximately the length of the fold, usually with two elongate papillae forming a groove perpendicular to the axis of the appendage and directed toward the opening. The opening is shaped and placed according to the structure and shape of the peg on the next appendage.

On the interior of the pocket are three folds, of which the median one is modified for the accommodation of the size of the pocket to fit the peg and according to the size of the appendage of the female that is clasped by this apparatus. There are other types of sockets, which will be described in connection with the species concerned.

The peg on the fourth appendage is located on the distal edge of the anterior surface of the basis near the base of the exopod (fig. 34, *d*). It is variously shaped according to the species. Generally it is some variation of a pear-shaped structure with a narrow tip turned laterally. On the proximal side and ventrally there is a chitinous ridge around the base of the peg extending obliquely across the appendage. It may be covered with very short spines or entirely unarmed.

The peg and socket apparatus is used entirely as a clasping medium. The last appendage of the female is clasped from the dorsal side, and the peg is fitted in the socket, which is enabled to accommodate itself by the folds already described. The accessory organs on the other appendages assist in this process. The abdomen of the male is twisted around that of the female first on one side, then on the other, so that the ejaculatory duct, located ventrally between the legs at the posterior end of the thorax, is brought directly in contact with the spermathecae of the female. These are located on the under side of the abdomen close to the thorax.

The testes are a pair of elongate bodies lying on each side of the midline in the abdomen. In the female the ovaries lie in the thorax and the spermathecae appear as small rounded bodies in the anterior end of the abdomen, often with a pair of tactile papillae projecting posteriorly from near the opening.

Two respiratory areas are located on the ventral surface of the carapace lateral to the body. The smaller of these may be anterior to the larger or may be mesial to and partially surrounded by it. Their function is considered as respiratory, because it has been found that there are blood sinuses under them limited by a single layer of hypodermal cells. In most instances these areas have a characteristic shape for a given species.

The anterior portion of the carapace and a portion of the lateral edges are flattened to fit against the body of the fish. These portions are armed with small spines directed posteriorly. The various ventral portions of the body of the animal that may come in contact with the body of the fish are also armed in the same manner.

CHARACTERS USED IN IDENTIFICATION

In a previous paper (Meehan, 1937) it was mentioned that many of the specific characters used at present for identification are variable in nature. Consequently positive identification is not possible unless mature male specimens are available. For the same reason it is difficult for persons unfamiliar with the actual specimens to know positively whether the species has been described if only the females are at hand. Therefore, it is felt that it would be of value to have some method for identification based upon characters that are more or less constant and that can be used for both sexes. A study of the specimens in the National Museum has shown that certain characters or combinations of characters can be used for this purpose and has indicated that some species are synonymous with others already described when the characters are fitted to them. So far there has been only one exception to the reliability of the characters selected, and it concerns a foreign species of which a more thorough study will be made later when other data are available.

The characters utilized are suitable for all the American fresh-water and salt-water forms. The most important of these are the respiratory areas. Wilson has said many times that they are specific, yet many descriptions have failed not only to figure them but even to mention them. In a few instances they are very similar in closely related species but are always slightly different and when combined with other characters serve to separate the species. Such examples are *maculosus* and *versicolor*. As the characteristic shapes are difficult to describe, they are figured for each species.

The segments making up the ribs on the rim of the suction cups are also specific. Although there is slight variation in the number of segments, the formation is very characteristic. In only two species examined was there any great difference in this respect. The male of *pugettensis* has a smaller number of segments than the female, with a basal segment of a different type. However, one vial containing immature specimens had females with typical segments like the male and stages between the two. Since these chitinous thickenings are known to develop at points of great stress, the difference in the two sexes might be attributed to the fact that the male is much smaller than the female and would probably develop fewer segments. In other instances there is some similarity in the segmentation, but when combined with other characters it loses its significance.

The antennae have characteristic appearances for some species and in many instances help in the identification. The number of spines, the character of their arrangement, and whether a spine or hook is found on the anterior surface of the first antennae are all of assistance.

On the second maxillae the teeth of the basal plate and the two pairs near the midventral line of the body may be characteristic in shape, size, or number.

Finally, the presence or absence of flagella on the swimming appendages, the shape of the swimming lobes on the posterior of the fourth appendages of the female, and other more variable characters may be used at times.

The maximum size as reported for each sex is given. Mature specimens of either sex within a species may vary considerably in this respect, and the sex difference may be great or small. Relative body proportions are not a reliable index for specific determination, since the proportions may change according to size, age, and stage of development. In a general way they do hold for sex comparisons; that is, the carapace may extend farther posteriorly on the male, or the length and width of abdomen or its shape may be different on the two sexes, etc., but on the whole they cannot be relied upon to establish specific identification. Color has been used in many instances, but it too cannot be depended upon as the sole basis or even in combination with proportional measurements for specific determination. All species are American fresh-water forms unless otherwise designated. All figures used are from camera lucida drawings of specimens in the National Museum and from the types where practicable.

SYNONYMY

Certain of the species listed in the literature have proved to be synonymous when studied according to the characters outlined for specific identification. *A. biramosus* Bere (1931) is identical with *appendiculosus* Wilson (1907). Any differences are merely a matter of size. *A. ingens* Wilson (1912b) is the same as *nobilis* Thiele (1904), as previously stated by Wilson (1924), but there seems to be no reason for maintaining a variety as he has done. *A. canadensis* Wilson (1916) is the same as *A. stizostethii* Kellicott (1880). There are no flagella on the latter, contrary to Wilson (1902), and he failed to note the complete respiratory area.

The male of *A. niger* has never been described, since it is the same as *pugettensis* except that the former is very dark, as its name indicates.

Vial 77810 (old number 60589) in the National Museum contains a male labeled *pugettensis* that is entirely different from the described male of that species and is from Key West, while the species has always been reported on hosts indigenous to the Pacific coast. This specimen has been given the new name *floridensis*. It was collected by A. E. Verrill and dated 1884.

Specimens labeled *A. megalops* var. *spinosis* in the Museum are not different from the regular species except that they are lighter in color; hence the spinous under portion of the body is more conspicuous. Color seems too variable to use in establishing differences. *A. varians*, recently described by Bere from females, is similar to *A. megalops* except for the great variation in the size of the carapace. Four specimens from the Bass Biological Laboratory show these gradations well.

The male of *A. latus* Smith (1873) has never been reported because it is identical with *funduli* Krøyer (1864) so far as the available specimens are concerned.

A. maculosus has been redescribed because no specimen was found to match the original description. The species was figured as having the characters of *americanus*. It was established on the basis of color. However, there are actual specimens of a species that may be considered as representing *maculosus*. As the types in the National Museum proved to be *americanus*, it is necessary to designate new types for *maculosus*.

A. piperatus Wilson (1920a) is identical with males of *A. flavescens* Wilson (1916), as described by Mueller (1936) and as collected by myself in Florida. *A. paulensis* is apparently the same as *A. salminei*, although no specimens of the latter are at hand.

Specimens of *A. japonicus* collected by Dr. Pearse in Japan and those sent me from that country proved to be identical with *A. trilineatus*, thus invalidating another species. There are, therefore, 21 North American, 2 South American, 2 Siamese, and 1 African species available for study in the Museum. These include all the North American species except some undescribed ones that Dr. Wilson has at the present time.

It is suggested that the key be used in combination with the figures of the respiratory areas in order that identification be accurate. The other figures may also be used to advantage, especially those of the male accessory copulatory organs.

DEVELOPMENT

Larval stages have been described for *A. foliaceus*, a European species, and for *A. funduli*, *A. megalops*, *A. americanus*, *A. maculosus*, *A. catostomi*, and *A. stizostethii* from this country. More recently T. Tokioka (1936b) has given a very good account of *A. japonicus*, which is also common in this country. Martin (1932) described the development of the proboscis from the early embryos of *A. viridis* in England. A generalized description of larval development is somewhat as follows:

The eggs are laid on a hard substratum in single or multiple rows and are arranged end to end or at slight angles to each other. As they are laid they are coated with a gelatinous substance that hardens on contact with the water, forming ridges, lumps, or wrinkles over the surface of each egg and is firmly attached to the eggs and substratum.

Batches of 30 up to 500 or 600 may be laid, depending upon the species, and vary in size from 0.375 by 0.25 to 0.64 by 0.43 mm. The period of hatching is somewhat variable. Tokioka found that the eggs of *A. japonicus* hatched in 12 days at 30° C. and in 60 days at 15° C. On the other hand, Wilson noted that *A. americanus* hatched in 18 days at 65° F. and in 17 days at 72° F., while *A. megaloops* required 60 days at the same temperature. Kellicott records a period of 81 days for *A. stizostethii* at room temperature. According to Wilson (1907), Clark observed *A. foliaceus* hatching at the end of 5 months 8 days, and 7 months 2 days where the eggs were laid in the fall and hatched the following spring.

Martin's observations on the early embryos throw light on the structure and development of the proboscis. At this time the mandibles are incurved with apices directed anteriorly toward the mouth opening and some distance behind it. The basal segment is large and bears a 3-segmented palp with three rami on the terminal segment.

On later embryos the basal segment has increased in size all out of proportion to the other segments. A rudiment of the lower lip becomes apparent in a position posterior to the mandibles, while the upper lip occurs anteriorly between the bases. Apparently the distal portions of the basal segments fuse with the upper and lower lips to form walls for the buccal cavity. The chitinous framework probably forms along the lines of greatest stress, since there is a great deal of individual variation.

First stage larva.—Larvae of this first stage may be of two kinds—one for the slower-hatching species, which are more fully developed and lack mandibular palps, and another for those that hatch more quickly and are less advanced in development. *A. japonicus* belongs to the latter group and will be used as an example, since the immature stages have been fully described by T. Tokioka as each molt occurred so that a most logical picture of development can be obtained.

The length of the hatching animal is 0.7 to 0.9 mm. Its carapace is oval, with short alae and with all the legs, the thorax, and the abdomen left exposed. Only the groove limiting the cephalic area is apparent. The dorsal ribs are unforked, while the joint behind the nauplius eye is lacking. The carapace, ahead of the brown compound eyes, is fringed with chitinous ciliary processes and a few spinules. Along the whole marginal area are many gland cells and some especially conspicuous ones at the base of the first antennae. The stomach has a simple pair of branches, forked only once.

The antennule is like that of the adult, but the proximal segment is lacking. Behind the antennule is the antenna composed of two basal segments with a spine on the posterior side of each. It has an unsegmented palp on the second segment and a 3-jointed distal portion ending in long plumose setae. The antennae are joined to a transverse chitinous bar on each side of which is a forward process and a backward spine—the postantennal spine of the adult.

A small sting is located at the base of the proboscis, which is essentially the same as that of the adult except that it is very short. The buccal fold is not yet serrated, and there are no labial processes or labial spines. The mandible is pointed, with an acuminate process on the lower margin near the tip, and the mandibular palp is attached by a chitinous framework at the base of the proboscis just behind the antenna. It is unsegmented, almost as long as the antenna, and ends in three long plumose setae. It is supported at the base by a circular framework of chitin, which forms a thickened area with a spine at the point of attachment. This framework serves to support the proboscis by means of the inner longitudinal rod already differentiated and an outer longitudinal rod to be differentiated at the next stage. Thus modified parts of the mandible proper form the supports of the proboscis.

The first maxillae are found on each side of the proboscis. They consist of three segments of which the basal one is bulky. On the tip are two large curved claws, one with three small processes on its anterior margin.

On the posterior distal corner of the basal segment of the 5-jointed second maxilla is a spine corresponding to the middle of the three spines found on the adult. The distal segment is provided with two curved claws and a papilla on the tip. Two pairs of spines are located near the midline of the body as in the adult—the postmaxillary spines.

Only the first pair of thoracic appendages is functional; the others are rudimentary and immobile, each with an unsegmented exopod and endopod. On the first appendage the coxa, basis, exopod, and jointed endopod are complete, but the precoxa is indistinguishable.

The abdomen is only about one-tenth as long as the body and has spinules along the posterior ventral side and margin. The caudal furcae are comparatively large. Sexes can be distinguished by the presence of rudimentary testes or small round seminal receptacles.

Second stage.—After three or four days the first molt takes place, and the animal assumes more the shape of the adult. It attains a length of 0.9 to 1 mm. The anterior margin of the carapace is fringed with ciliary processes as far back as the first maxillae. The

anterior marginal groove on the carapace is distinguishable, and the joint in the dorsal ribs is just discernible.

On the first antennae the proximal segment is faintly defined and has a spine projecting backward, while the third segment has developed a small process with two setae at the end. The palp on the second antenna as well as the spine on the posterior margin of the second segment has disappeared, but a seta has developed on the anterior distal margin. The third segment is still small, the fourth approximately the same as in the previous stage, while the fifth is longest and ends in a number of long setae. Only a pair of post-antennal spines remain where the transverse chitinous bar occurred before the molt.

The mandibular palp has disappeared and the chitinous framework that connected it to the mandible is a simple longitudinal support, but the junction of this rod to the mandible is still thickened into a spine, which gradually disappears with each successive molt. A chitinous thickening occurs on each side of the anterior transverse bar along the buccal fold foreshadowing the serrated margin of the adult. The small labial processes are clearly seen although the labial spines are absent. There is a pair of spines in front of the mouth opening.

The first maxillae consist of four segments by division of the basal segment into two. The more distal of these has two spines on the ventral proximal margin. A spine has developed on the posterior margin of the second maxilla (the inner spine of the adult), and the second segment has become somewhat longer than the more distal ones. Spinules have made their appearance on the ventral side of the thorax, and ramifications of the stomach have become slightly more complex.

All the swimming appendages have assumed the shape of those on the adult and serve as locomotor organs in the place of the antennal and mandibular palps. A number of plumose setae have developed on each. The abdomen is one-seventh to one-sixth as long as the body, with the lobes projected slightly backward and spinules on the margins.

Third stage.—When the larva has reached an age of five to seven days a second molt occurs. The main difference noted between second, third, and fourth stage larvae is in the pattern of the first maxillae, the number of spines on the basal segment of the second maxillae, small differences in size and number of setae and spinules, and in the pattern of the branches of the stomach.

The larva has reached a length of 1.0 to 1.2 mm. Behind the nauplius eye the joint of the dorsal ribs is clearly visible, the posterior transverse bar of the proboscis can be seen, and the buccal fold has a process on its free margin.

The first maxillae have reached the highest point of development as a clasping organ and in the next stages will begin to degenerate. The boundary between the basal and second segments is becoming indistinct, two spines on the second segment have disappeared, and the framework of the suction cup is faintly seen within the basal segment. On the second maxillae a small spine has been added to the basal segment at the posterior distal corner (the outer spine of the adult), and some minute spinules have made their appearance.

A few spinules occur for the first time on the ventral surface in front of the anterior marginal groove and along the margin of the carapace adjacent to the anterior respiratory area. Rudiments of the flagella are formed on the posterior dorsal corner at the base of the exopod of the two anterior pairs of swimming legs. On the female a minute chitinous spine appears at the extremity of the duct of the seminal receptacle.

Fourth stage.—A larva seven to eight days old molts for a third time and has reached a length of 1.2 to 1.4 mm. The lateral lobes of the carapace barely cover the second swimming appendages. Branches of the lateral groove limiting the cephalic area are faintly seen extending inward. The anterior dorsal ribs show a rudimentary outer branch, and the ciliary fringe of the carapace extends as far back as the second maxillae.

Both pairs of antennae are the same as in the previous stage, but the buccal fold of the proboscis has two teeth on the free margin. On the basal segment of the first maxillae there is a considerable expansion due to the formation of the suction cup. The circular margin is fringed with minute triangular processes, and the muscles attached to it can be seen through the chitinous exoskeleton. Buds of the flagella on the first two pairs of thoracic appendages are still very small and without any setae. On the male the posterior side of the joint between the coxa and basis of the third leg is deeply cut where it foreshadows the socket of the adult. The abdomen of the female is slightly smaller than that of the male.

Fifth stage.—Three to four days after the third ecdysis a fourth molt occurs, and the larva reaches 1.3 to 1.7 mm. in length. The outer branches of the dorsal ribs are still short and the ciliated margin of the carapace has extended almost to the first thoracic segment.

The two basal segments of the second antennae have several setae on the distal end. The third segment is small, the fourth twice as long as the third, with the two setae that occurred on the segment in the preceding stages moved to the distal end. The last segment is as long as the fourth and is tipped with a few rather thick setae.

The labial spines are distinctly located on the floor of the buccal cavity. Important changes have also occurred in the first maxillae.

The basal segment has broken and the suction cup is exposed, although the remaining segments are still intact. The suction cup is exactly the same as that of the adult except that the number of segments in the chitinous ribs supporting the margin is smaller. Each rib is composed of one long and two short segments, with the distal one only faintly defined. The basal segments of the second maxillae have two long setae in the middle of the posterior margin of the scaled area besides many scales on the surface.

The branches of the stomach have become fairly complex. On the first thoracic leg the rudimentary flagellum has two setae while that on the second leg has one. On the ventral posterior edges of the coxa of the second leg of the male the bilobed prominence is laid down. On the third leg the socket is indicated by two lateral folds and a projection on the ventral side that will become the median fold. The precoxa and coxa of each leg have small spinules or scales on the ventral side. The abdominal lobes have grown considerably and the anal sinus reaches about one-fourth the length of the abdomen.

Sixth stage.—The difference between the fifth, sixth, and seventh larval stages is found in the residual portion of the first maxillae and in the degree of development of the male accessory copulatory apparatus. These stages cannot be distinguished in the female because of the great variation in the size.

They have attained a length of 1.6 to 2.0 mm. The residuum of the first maxillae shows no segmentation. On the second and third legs the accessory apparatus is the same, but a rounded prominence has made its appearance on the anterior distal corner of the basis of the fourth leg where the peg of the male will be located. The abdominal processes are faintly defined at the base of the abdomen in the female.

Seventh stage.—The sixth and seventh stages are attained in 10 to 18 days. At this time the animal has reached a length of 2.0 to 2.2 mm. The lobes of the carapace have extended to cover the third legs, and the dorsal ribs are distinctly forked. On the first maxillae the residual degenerating portion consists of a small process provided with a minute spinule, while the ribs of the suction cups have added a short segment.

On the first two swimming legs the flagella have become longer and reach beyond the proximal margin of the basis. They are provided with several plumose setae. On the male the bilobed protuberances of the coxae of the second legs are fairly conspicuous, and the socket of the third pair is almost complete, although the papillated processes in front of the aperture are not yet apparent. On the fourth leg the peg is almost like that of the adult. It is provided with a lobed process on the ventral side, and the tip ends in

a terminal chitinous process with a small spinule. The chitinous framework supporting the peg continues to the posterior proximal edge of the basis across the dorsal side of the segment, where the chitin is thickened conspicuously. On the female the posterior portion of the coxa of this appendage protrudes and will be the natatory lobe of the adult.

The abdomen differs in shape with the sexes. On the male the lobes are larger and bluntly pointed while the smaller ones of the female are rounded.

After the seventh stage there is no well-defined characteristic; the change brought about by molting is merely in grade. The earlier stages are very regular, but the later stages, after the fourth, are very irregular and hard to define.

Molting takes place by rupture of the exoskeleton along the midline from the anterior marginal groove to the anterior thoracic segments. The animal draws out the thorax and abdomen through this slit first. Then the anterior portion of the carapace is withdrawn and finally the lateral lobes. This ecdysis occurs over the whole body except the coat of the suction cups, which comes off after the molting process of the other portions is through.

Subsequent development.—From this time on the lateral lobes of the carapace enlarge, and all the grooves on the dorsal surface become distinct while the longitudinal groove appears later. The ramifications of the stomach become more complicated, and pigment spots on the oviduct appear about the twentieth day after hatching. The suction cup loses the residual portion of the maxilla except a tiny seta, which remains for a long time. A papillated process on the anterior margin of the precoxa of the third leg and small processes in front of the aperture of the socket of the male are formed at a later stage.

The abdomen grows somewhat and the animals become sexually mature during these molts. Development is completed about one month after hatching.

It will be noted that the account by Tokioka describes seven well-defined larval stages with subsequent molts, which serve to bring the animal to sexual maturity. Wilson was indefinite as to the number of molts, but in one place indicated that he had observed four. It is also worthy of note that no mention is made of any maxillae within the proboscis and that the two pairs of appendages immediately behind the proboscis are called first and second maxillae.

Family ARGULIDAE

Genus ARGULUS Müller

KEY TO THE SPECIES OF ARGULUS

- α^1 . Anterior respiratory area prolonged laterally around posterior one (club shaped).
- β^1 . Teeth of basal plate of second maxillae sharp, widely separated; suction cups supported by about 10 to 12 plates plus an elongate segment; posterior swimming lobe of fourth appendage on female rounded, abbreviated on male; fresh water..... *stizostethii* (p. 479)
- β^2 . Teeth of basal plate of second maxillae blunt, postmaxillary spine small and blunt; flagella present on first two swimming appendages; suction cups supported by 4 to 6 plates plus an elongate segment; respiratory area relatively narrow; posterior swimming lobe on female prolonged into a fingerlike projection, only slightly prolonged on male; fresh water, Siam..... *siamensis* (p. 482)
- α^2 . Smaller respiratory area anterior, mesial, or in an anteromesial notch of larger area.
- β^1 . Entire smaller respiratory area anterior to larger.
- δ^1 . Teeth on basal plate of second maxillae sharp, distal one more widely separated than other two; ribs of suction cups composed of 10 to 12 plates and an elongate segment; carapace just reaching third thoracic appendages; anterior hook on antennae slight or lacking, second antennae long; last thoracic segment very wide, flaring over abdomen; brackish and salt water..... *alosae* (p. 481)
- δ^2 . Basal plate of second maxillae lobed or with slender blunt teeth.
- δ^1 . Tips of maxillary teeth blunt, but plate not lobed.
- e^1 . Ribs of suction cups supported by rods.
- f^1 . Ribs of suction cups composed of 3 rods; knob or hook lacking on anterior surface of first antennae; swimming lobe of fourth appendages boot-shaped, heel pressed against end of thorax, toe extending to or beyond edge of abdomen; whole body appearing circular; anterior respiratory area minute, posterior one very large and oblong; salt water, Siam, Java..... *indicus* (p. 483)
- f^2 . Supports of suction cups composed of 4 to 6 rods, distal ones may be compressed; anterior hook present on antennae, a seta two-thirds as long as two distal segments of second antennae, and opposing them, a long seta opposing tip of first antennae; slight posterior lobe on fourth appendages rounded or faintly boot-shaped; fresh water..... *flavescens* (p. 484)
- e^2 . Suction cups supported only by imbricate plates or by plates and a long basal segment.
- f^1 . Suction cups supported only by imbricate plates; spine at base of first antennae and near midline of body (postantennal) broad and blunt.

- g*¹. Plates of supporting ribs numbering up to 30 or more; knob present on anterior surface of first antennae; second maxillae slender; salt water, Pacific coast----- *melanostictus* (p. 487)
- g*². Plates in supports numbering about 15 to 20; carapace reaching abdomen; anterior hook present on first antennae.
- h*¹. First two swimming appendages with flagella; second maxillae short and stout with spinous pads on ventral surface, postmaxillary spines short and truncate; antennae short; salt water, Pacific coast----- ♀ *pugettensis* (p. 487)
- h*². First two swimming appendages without flagella; second maxillae about normal in size, proximal tooth on basal plate broader, two pairs of postmaxillary spines not truncate; second antennae longer; salt water, Key West--- *floridensis* (p. 489)
- f*². Suction cups supported by an elongate proximal segment and imbricate plates.
- g*¹. First two pairs of swimming appendages without flagella.
- h*¹. Respiratory areas small and widely separated; proximal segment in ribs of suction cups elongate and narrow; posterior lobe of fourth appendages of female somewhat bilobed; anterior knob present on first antennae; salt water, British Columbia----- *borealis* (p. 490)
- h*². Respiratory areas normal (one large and one small).
- i*¹. Maxillary spines about alike, posterior respiratory area large and irregular in shape; swimming lobe on posterior surface of fourth appendages boot-shaped on female; salt water----- *megalops* (p. 492)
- i*². Lateral spine on basal plate of second maxillae blunt, other two more pointed; anal sinus deep.
- f*¹. Suction cups occupying almost full width of carapace, supporting ribs composed of 6 to 10 imbricate plates and a rectangular basal segment; spine on ventral surface of hook inconspicuous, all others broad; posterior respiratory area reaching close to anterior one and about same width for its full length; salt water----- *bicolor* (p. 517)
- f*². Suction cups normal, supporting ribs composed of 6 or 7 imbricate plates (12 to 14 on female) with rectangular basal segment; spine on ventral surface of hook prominent, postantennal spines larger than others; posterior respiratory area some distance from anterior one, anterior half narrower than posterior portion; salt water----- *fuscus* (p. 518)

- ♂.** First two pairs of swimming appendages with flagella.
- h¹.** Conspicuous anterior hook on first antennae, antennae short, broad spine at base of first antennae and broad postantennal spine; second maxillae broad and short with spinous pads over ventral surface, postmaxillary spines short and truncate, anterior pair on papillae; salt water, Pacific coast..... *♂ pugettensis* (p. 487)
- h².** Knob present on anterior surface of first antennae; dorsal ridges branched at anterior end; posterior respiratory area somewhat reniform; fresh water, universal..... *japonicus* (p. 494)
- ♂.** Basal plate of second maxillae lobed.
- e¹.** Lobes of second maxillae truncate; hook present on anterior surface of first antennae; supporting ribs of suction cups composed of rods.
- f¹.** Lobes of second maxillae appearing worn, postmaxillary spines truncate and inconspicuous, anterior knob on first antennae long and fingerlike, with slight anterior hook; supports of suction cups composed of 3 straight rods; salt water..... *laticauda* (p. 495)
- f².** Basal plate of second maxillae with truncate or rounded teeth, postmaxillary spines conspicuous; supports of suction cups composed of 4 or 5 rods; posterior respiratory area reniform, anterior hook on first antennae stout; fresh water, Congo River, Africa..... *reticulatus* (p. 497)
- e².** Lobes of second maxillae not truncate.
- f¹.** Two pairs of postmaxillary spines missing, proximal lobe of basal plate more distinctly separated than the one or two lateral ones; respiratory areas small and widely separated; suction cups with about 16 plates in supporting ribs with a proximal plate slightly longer than the others; anterior knob of antennae almost wanting; swimming appendages without flagella; salt water, New Orleans to New Brunswick..... *funduli* (p. 498)
- f².** Two pairs of postmaxillary spines present.
- g¹.** Lobes of second maxillae and postmaxillary spines very broad with spinous papillae on them; supports of suction cups with one long and one oblong rod; spines at base of first antennae and postantennal spines extremely broad and blunt, anterior hook broad at base and very long; anterior respiratory area very small and posterior one extremely long; fresh water, Uruguay..... *violaceus* (p. 500)
- g².** Edge of basal plate of second maxillae with broadly rounded lobes, mesial lobe somewhat more prominent, postmaxillary spines very blunt and short; knob present on anterior surface of first antennae, distal segment opposed by a spine, second antennae without much enlargement of basal segments,

- spines slight or indicated by protuberances at base of first antennae as are the postantennal spines; supporting ribs of suction cups tapering, composed of 9 or 10 segments; fresh water, Brazil----- salminei (p. 502)
- b⁴. Smaller respiratory area mesial to larger or in an antero-mesial notch of latter.
- c⁵. Spine present at the base of first antennae.
- d¹. Three spines in a row on each side of midline of body, including those at base of first antennae.
- e¹. Smaller respiratory area located anteromesially in a notch of the larger one, both posterior to the second maxillae; supporting ribs of suction cups composed of 2 or 3 segments; distal lobe on basal plate of second maxillae blunter and wider than others; basal segment of first antennae usually prolonged into a knob directed toward the midline of body; fresh water.
americanus (p. 504)
- e². Smaller respiratory area in a notch proximal to and some distance behind anterior end of larger; supporting ribs of suction cups composed of more than 2 segments.
- f¹. Second maxillae with slender teeth of basal plate widely spaced; first segment of supporting ribs of suction cups elongate and narrow followed by 2 or 3 oblong ones; knob present on anterior surface of first antennae; carapace reaching abdomen; abdomen subtriangular; fresh water----- versicolor (p. 505)
- f². Teeth of basal plate on second maxillae close together and long; supporting ribs of suction cups composed of a rectangular basal and 2 distal segments in male and 4 to 7 in female; anterior hook present on first antennae; carapace extending to third appendages; abdomen somewhat rectangular; fresh water.
maculosus (p. 507)
- d². Postantennal spines 2, suction cups with about 5 slender segments in ribs extending two-thirds of width of rim of disk; lateral hook of first antennae curved in an arc, tip of first antennae biramous; postmaxillary spines very small; broad posterior lamellae on basis and coxa of fourth thoracic appendages; animal characteristically broad and leaflike in appearance; fresh water.
mississippiensis (p. 509)
- c². No spine at base of first antennae.
- d¹. Basal plate of second maxillae lobed or with slender blunt teeth; no spine on ventral surface of first antennae or at base of first or second antennae.
- e¹. Basal plate of second maxillae with 2 to 4 lobes, usually 3, postmaxillary spines absent; anterior knob present on first antennae; ribs of suction cups with 7 to 9 short rods, fresh water----- castostomi (p. 511)
- e². Three slender blunt teeth on basal plate of second maxillae; only a slight indication of a knob on the anterior surface of the first antennae, tip of flagellum biramous;

- suction cups supported by 2 long segments in ribs;
dorsal ridges of carapace branched at the anterior
end; fresh water----- *appendiculosus* (p. 512)
- d. Teeth of second maxillae very sharp; no spine at base of
first antennae; ribs of suction cups composed of rods.
- e. Ribs of suction cups with 8 or 9 rods: lateral hook of
first antennae short but curved back on itself; fresh
water----- *lepidostei* (p. 514)
- e. Ribs of suction cups with about 12 to 18 rods; tip of
first antennae biramous, with one of the branches
biramous; abdomen heart-shaped in female, with lat-
eral projections on the anterior edges in male;
fingerlike protuberances on distal anterior end of first
segment of endopod on third and fourth thoracic ap-
pendages; fresh water----- *nobilis* (p. 515)

ARGULUS STIZOSTETHII Kellicott

FIGURE 22

Argulus stizostethii KELLICOTT, 1880, p. 53.—WILSON, 1902, p. 713, pl. 17.
Argulus canadensis WILSON, 1916, p. 348, pl. 60; 1936a, p. 355, figs. 1-9.

Carapace elliptical, reaching to second or third swimming appendages, sinus shallow; cephalic area prominent, projecting slightly anteriorly. Abdomen somewhat elongate with sides parallel, anal sinus deep, tips of abdomen pointed and diverging somewhat, anal furcae basal. The respiratory areas are peculiar in that the anterior one is prolonged laterally around the posterior one in such a way as to be club-shaped instead of rounded (fig. 22, *a*). As the type of *canadensis* has a very broad mesial respiratory area, the inner edge may easily have been overlooked by Wilson in his description.

The hook on the anterior surface of the first antennae is tight against the body of the antenna in the type of *canadensis* instead of having the usual elongate base; spine present on midventral surface of antennae and at the base. Spines located at the base of the second antennae, near the midline of the body, and the postantennal spines are stouter than the others. The ribs of the suction cups are composed of a stout pedestal with 10 or more apparently imbricate plates (fig. 22, *b*). Second maxillae stout; basal plate large and broad with a large pad; teeth small and sharp, widely separated; two usual pairs of spines are located near the midline of the body but the anterior pair are stouter.

Flagella are lacking on the swimming appendages; female with a small rounded natatory lobe on the posterior surface of the coxa on the fourth appendages; basal segments stout. Second appendages of male (fig. 22, *c*) with the usual bilobed flap on the coxa. Basis of third appendages much abbreviated, with a papilla across the ante-

rior surface; distal end of coxa has a larger papilla parallel to that of the basis so that there appear to be two ridges across the anterior side near the origin of the rami; the coxa is widened somewhat to a point near the middle, but no enlargement is formed for the socket. The socket consists of a shallow groove running dorsolaterally from the middle of the segment to a point just below the large papilla with the deepest part farthest inward. On the fourth appendages the peg is placed on the distal edge of the basis near the origin of the exopod as a slight fingerlike papilla with the tip turned mesially, a second mesial papilla bends outward to meet it. The usual chitinous ridge runs obliquely around the base; natatory lobe is much reduced. The exopod is attached to the basis by a bent kneelike portion, thus separating the two rami considerably.

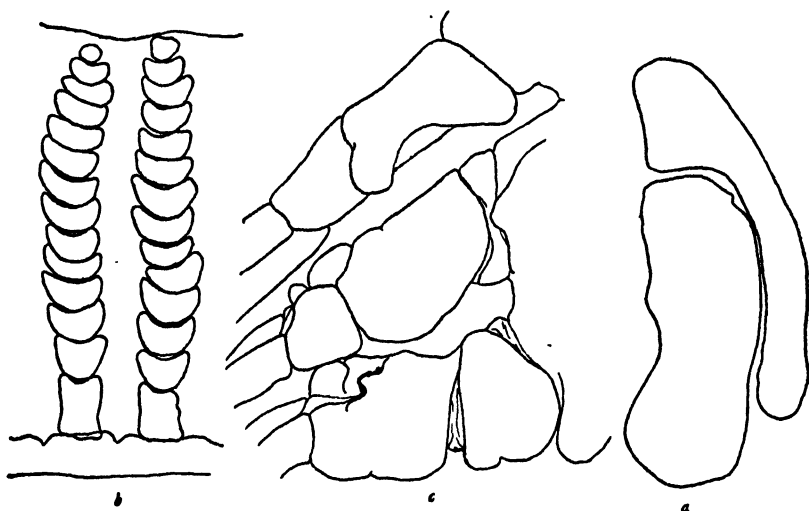


FIGURE 22.—*Argulus stizostethii*: a, Respiratory areas; b, ribs of suction cups; c, male accessory organs of second, third, and fourth legs.

Females have been reported to 12 mm. and males to 8.5 mm. They have been reported from the wall-eyed pike (*Stizostedion vitreum*), Niagara River, Buffalo, N. Y.; *Cynoperca canadensis*, Fairport, Iowa; *Coregonus* and *Acipenser fulvescens*, Le Claire, Minn.; brook trout, stickle-backs, perch, and suckers, Cape Breton Island, New Brunswick; *Esow masquinongy*, Vilas County, Wis.; skin of salmon, St. John, New Brunswick; swimming in Lake Erie.

The only difference that could be noted between *stizostethii* and *canadensis* is a slight variation in size and shape of body and some structures. These were no greater than variations within the species. There is some tendency for the occurrence of aberrant types of external respiratory areas in some specimens.

ARGULUS ALOSÆ Gould

FIGURE 23

Argulus alosæ GOULD, 1841, p. 340.—WILSON, 1902, p. 707, pl. 12, pl. 28, fig. 80; 1932, p. 17, fig. 6.

Carapace of female elliptical, male ovate; cephalic area very prominent; eyes comparatively large and set wide apart. Last thoracic segment is very wide and flares over the abdomen. Abdomen with points flaring, sinus shallow and wide, anal furcae minute and basal. Respiratory area reaching to the base of the suction cups, anterior small one slightly oblong, posterior one reniform (fig. 23, *a*).

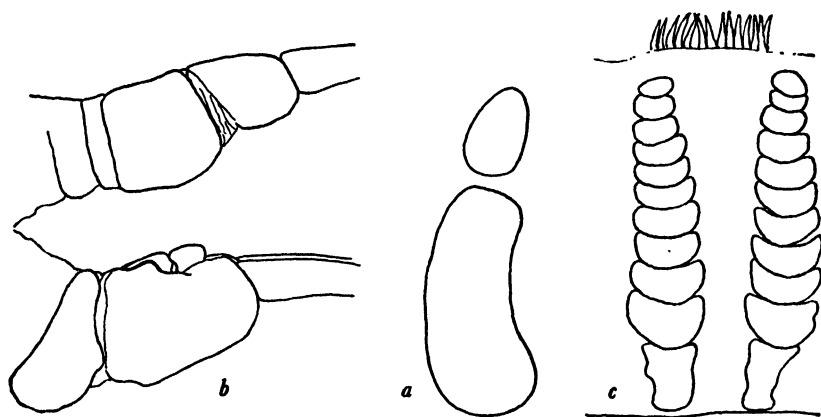


FIGURE 23.—*Argulus alosæ*: *a*, Respiratory areas; *b*, male accessory organs of third and fourth legs; *c*, ribs of suction cups.

Antennae with anterior hook, weak, but lateral hook curved back some distance; spine on ventral surface fairly large, a large one at the base; a medium one at the base of second antennae, and a very large one at the midline. Second antennae comparatively long and slender. Suction cups large, ribs in rim made up of 10 to 12 imbricate plates with an elongate one at the base; marginal lappets long and narrow with setae at the ends (fig. 23, *c*). Second maxillae with wide basal plate, short, sharp teeth, widely separated, lateral one more widely separated than the others. Both pairs of postmaxillary spines pointed.

Swimming appendages without flagella, normal on the female except for a posterior bilobed coxa on the fourth appendages. First two pairs unmodified on male, peg merely a rounded papilla on the dorsal distal edge of the basis which fits into a posterior rounded cone-shaped lobe on the posterior surface of the third appendages, so that the papilla appears to overlap the socket when viewed either dorsally or ventrally (fig. 23, *b*).

The female measures up to 12 mm. and the male up to 6 mm. It has been found on the following hosts: *Clupea vernalis*, *Dorosoma cepedianum*, *Pomolobus pseudoharengus*, *P. strongylura marina*, and *Osmerus mordax* from the Woods Hole region; *Gasterosteus bicaculeatus* in the Gulf of St. Lawrence; *Microgadus tomcod*, Base River, Nova Scotia; *Otenolabrus adspersus*, Casco Bay, Maine, Great Egg Harbor, N. J., Key West, Fla., Patapsco River, Baltimore City, a fresh-water tow in the Shubenacadie River, Nova Scotia; and from the "toadfish," Shell Point, Fla.

ARGULUS SIAMENSIS Wilson

FIGURE 24

Argulus siamensis WILSON, 1926, p. 361, pl. 22.

Carapace ovate, reaching fourth appendages in the female, overlapping abdomen in the male; cephalic area narrow, posterior sinus broad. Abdomen elliptical, anal sinus deep, tips acute, slightly divergent. Respiratory areas with anterior one club-shaped and curved around posterior one, but slenderer than that of *stizostethii* (fig. 24, *a*).

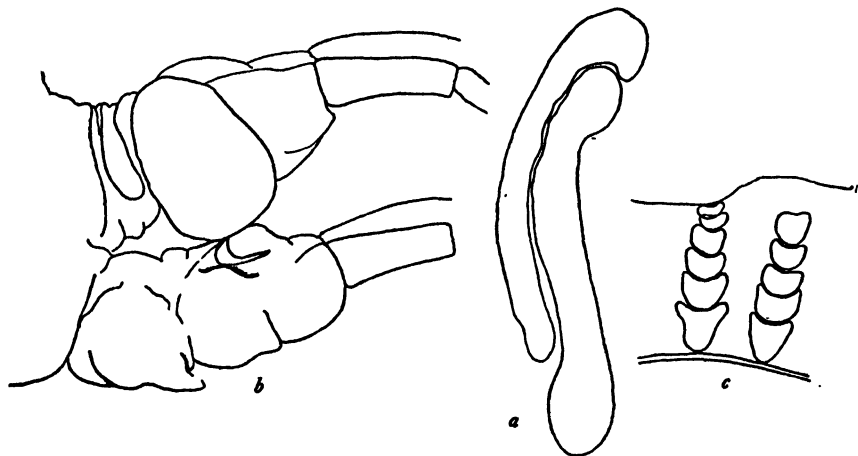


FIGURE 24.—*Argulus siamensis*: *a*, Respiratory areas; *b*, male accessory organs of third and fourth legs; *c*, ribs of suction cups.

Antennae with slight anterior knob, lateral hook long; ventral spine blunt, spine at base of first antennae long and blunt, that at base of second antennae small and transparent, postantennal spine long and blunt. First antennae relatively stout, second antennae very long. Second maxillae with broad basal plate, teeth broad and blunt, both pairs of spines near midline of body small and blunt. Suction cups with ribs of four or five imbricate plates and a longer basal one (fig. 24, *c*).

Swimming appendages with flagella. Fourth leg with posterior boot-shaped lobe in female, with toe drawn into a long fingerlike tapering process. On third appendages of male (fig. 24, *b*) the pre-coxa is slightly broadened; the coxa is rounded posteriorly where the socket is located, with a meager swelling anteriorly. On the fourth appendages is a posterior bilobed process with a scant lateral prolongation suggestive of the female. There is a small chitinous ridge around the peg. The peg itself originates a short distance back from the distal edge of the basis and projects ventrally against the anterior surface as a short fingerlike papilla.

The female is up to 6.55 mm. and the male up to 3.5 mm. Taken on *Cirrhina* sp. and *Trichopodus* sp. from fresh water at Bangkok, Siam.

ARGULUS INDICUS Weber

FIGURE 25

Argulus indicus WEBER, 1892, p. 544, fig. 1.—VAN KAMPEN, 1909, p. 447, figs. 5, 6.—WILSON, 1927, p. 1, pl. 1.



FIGURE 25.—*Argulus indicus*: *a*, Respiratory areas; *b*, ribs of sucking cups; *c*, antennae.

Carapace broadly rounded, alae covering over half of abdomen so that the whole animal is almost inclusive in a circle. Cephalic area prominent; dorsal ridges branched anteriorly; eyes small, without much pigment; abdomen wider than long, sinus deep, sides diverging, anal furcae subterminal. Whole animal dark colored, flecked with black. Anterior respiratory area minute, about opposite the second maxillae, posterior oblong area very large (fig. 25, *a*). Only the female is known. It measures about 7.75 mm. The host is *Betta* sp. from near Bangkok, Siam.

Lateral hook on first antennae short, without an anterior knob; basal and post antennal spines large; flagellum of first antennae

small, second antennae long (fig. 25, *c*). All spines are dark colored. Suction cups moderate, rim narrow, ribs composed of three rods, marginal lappets long (fig. 25, *b*). Second maxillae slender, basal plate with three large teeth; two pairs of prominent postmaxillary spines.

Thoracic appendages very long, first pairs with flagella; slight prominence with setae on the distal posterior surface of the coxa of third appendages on female; prominent boot-shaped natatory lobe on posterior of fourth appendages extending laterally as far as the base of the rami, with the heels pressed against the posterior end of the thorax; slight setose posterior lobe on the basis.

ARGULUS FLAVESCENS Wilson

FIGURE 26

Argulus flavescens WILSON, 1916, p. 349, pl. 61, figs. 7-12.—MUELLER, 1936, p. 807.
Argulus piperatus WILSON, 1920a, p. 149, figs. 1-7.

Carapace longer than wide, sinus more than one-third the length; abdomen ovate on female, elliptical on male, lobes rounded and often touching on the inner margins on the female, sinus giving the impression of being wider at the base; anal papillae basal, small, and rounded.

On the type there are lateral expansions into the carapace. These are called "lateral lobes of the stomach" by Wilson, but they are really expansions from the egg-filled ovaries. They occur only on gravid females, while those partially spent may have one side filled or only a few eggs remaining. Thiele noted these expansions on *A. africanus* in the Berlin Museum.

The anterior respiratory area is small and subtriangular, while the other is very large with a broader posterior portion (fig. 26, *b*). The females reach up to 6 mm., while the males are smaller.

First antennae with a slender lateral claw, anterior knob with a slight hook, flagellum about the length of lateral hook, tip biramous. Second antennae long, distal joints slender, spine at base; postantennal spines long and larger than others; ventral surface of distal segments armed with setae.

Suction cups with the ribs on the rim made up of four to six rods, the distal ones somewhat compressed (figure 26, *c*). Second maxillae with three blunt teeth on the basal plate, long setae on the pad of the basal disc (fig. 26, *a*). Postmaxillary spines fairly long. On southern specimens any or all may have a worn appearance.

Swimming appendages with flagella on the two anterior pairs. Second pair of male appendages with a posterior lobe on the ventral side of the precoxa, and the usual spinous pad on the coxa (fig. 26, *d*). Third pair of male appendages with a broader lobe on the posterior of the precoxa than on the preceding appendages and a long lobe over the coxa and basis that contains the socket. The peg is located on the distal anterior angle of the basal segment with a very broad base. It

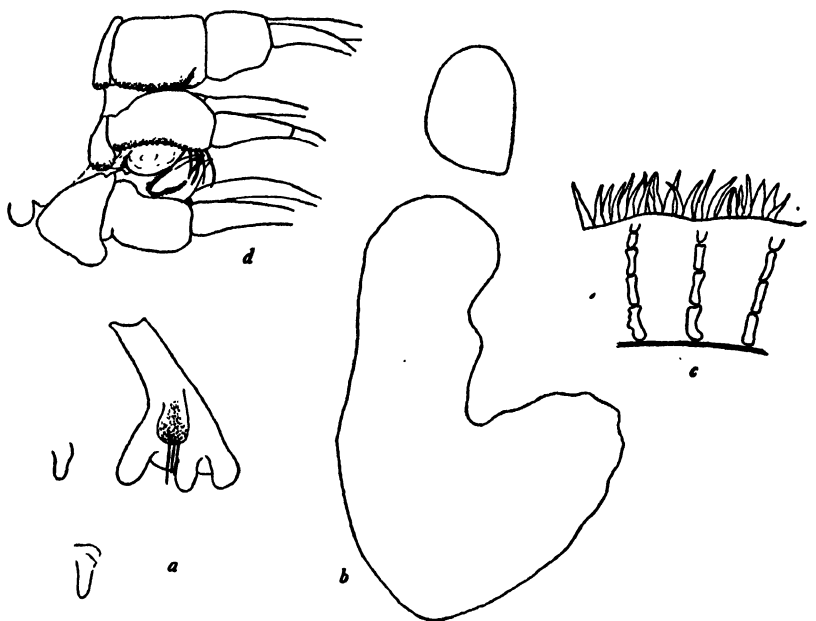


FIGURE 26.—*Argulus flavescens*: *a*, Basal plate of second maxillae and mesial spines; *b*, respiratory areas; *c*, ribs of suction cups; *d*, ventral view of male accessory organs of last three legs.

is divided longitudinally into two parts. The distal portion is slender, while the proximal portion is broad with a broad bluntly rounded tip and with transverse bands or chitinous ribs. On the ventral surface is a fleshy lobe directed obliquely toward the appendage much like that of *A. japonicus*. There is the usual chitinous ridge around the base of the peg, and a boot-shaped (in some cases more rounded) posterior lobe on the coxa. The total length of the basal segments of the three posterior appendages is progressively shorter toward the posterior. A large lobe is located at the opening of the ejaculatory duct. Both sexes are flecked with pigment.

The males of *piperatus* in the Museum are similar to Mueller's figure of *flavescens* and to specimens of the latter collected by myself in Florida. The distribution extends from Nova Scotia to Florida. They have been found on *Amia calva* and *Leptops olivaris* at Fairport, Iowa; free swimming in the Schubencadie River, Nova Scotia; on *Hypentelium nigricans* from the Ohio River at Marietta; on *Huro salmoides* in the Myakka River and *Amia calva* in Lake Okeechobee, Fla., and on *Ameiurus nebulosus* and *Huro salmoides* at Welaka, Fla.

Additional Florida hosts reported by Dr. R. V. Bangham include:

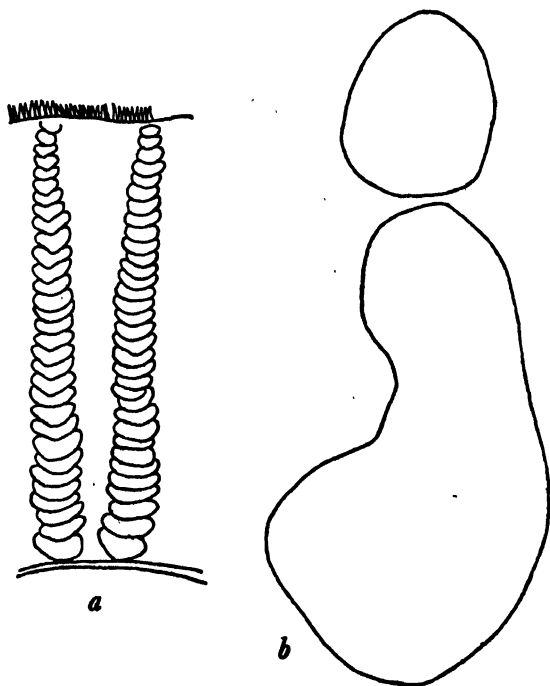


FIGURE 27.—*Argulus melanostictus*: a, Ribs of suction cups; b, respiratory areas.

Chub sucker (*Erimyzon sucetta sucetta*) at El Jobean; stump knocker (*Eupomotis micralophus*) at Naples, Englewood, and Lake Okeechobee; gold-spotted killifish (*Fundulus* sp.) at El Jobean; yellow bullhead (*Ameiurus natalis*), Myakka River; *Amia calva* at Joshua; marbled bullhead (*Ameiurus* sp.) from Lake Okeechobee and Englewood; largemouth black bass (*Huro floridana*) at Naples and Englewood; channel catfish (*Ictalurus punctatus*), Lake Okeechobee; and warmouth bass (*Chaenobryttus gulosus*) from a roadside ditch at Englewood. The list of hosts and the area of distribution are therefore very imposing.

ARGULUS MELANOSTICTUS Wilson

FIGURE 27

Argulus melanostictus WILSON, 1935b, p. 776, pl. 25, figs. 1-4.

Carapace about as wide as long, extending to third thoracic appendages; cephalic area projecting; eyes large, well separated; dorsal ridges bending sharply laterally ahead of the eyes; posterior sinus wide, sides flaring. Abdomen elliptical, lobes acute, sinus cut past center, tips flaring starting at middle of sinus; anal furcae basal. Body flecked with dark color. Respiratory areas include a rounded one near the suction cups and a posterior, larger somewhat J-shaped one posteriorly (fig. 27, *b*). Only the female of this species is known, and it reaches 8 mm. in length. It was taken in a tow at Monterey Bay, Calif., and there is a second record from Siam. Host unknown.

Antennae small, lateral hook short, anterior knob small, ventral median spine of lateral hook broad and blunt, spine at base of first antennae extremely large, that at base of second antennae long, postantennal spine extremely broad and blunt. Suction cups with edge supported by ribs composed of up to 30 or more apparently imbricate plates (fig. 27, *a*). Second maxillae have the penultimate segment enlarged and armed with spines. Basal plate very broad with short blunt teeth; spines at base of limb near midline on a broad prominence, second pair slenderer and more pointed and somewhat inconspicuously located.

Swimming appendages bearing flagella on anterior two pairs. Fourth pair with small boot-shaped natatory lobe on the coxa. Slight ventral posterior ridge on the coxa of the second and third appendages. Tactile papilla not apparent.

ARGULUS PUGETTENSIS Dana

FIGURE 28

Argulus pugettensis DANA, 1853, p. 1351, pl. 94, fig. 2a, b.—THORELL, 1865, p. 60.—WILSON, 1902, p. 711, pl. 15.—THIELE, 1904, p. 32, figs. 77-82.
Argulus niger WILSON, 1902, p. 714, pl. 18.

Carapace of female elliptical, covering appendages and extending onto the abdomen; cephalic area prominent with lateral sinuses deep. On the male the carapace is more nearly orbicular, covering only the third appendages; eyes small and widely separated. Abdomen of female ovate, lobes rounded, sinus very deep; on male elliptical, lobes pointed, sinus less than half the depth; anal papillae basal. The respiratory areas are composed of an anterior small rounded portion and a stout J-shaped larger area posteriorly (fig. 28, *b*). The male

openings are near two small rounded papillae, while the tactile papillae of the female are short and stout. The whole under surface of both sexes is very spinous.

Antennae comparatively small; anterior hook very conspicuous, flagellum very short; second antennae short; spines at base of first and second antennae very stout, postantennal pair stouter, those on ventral surface of lateral hook long and sharp. Suction cups on male about one-fifth the width of carapace, ribs composed of basal pedestal and 7 to 10 imbricate plates (fig. 28, *c*); those of female composed of approximately 16 imbricate plates (fig. 28, *d*). Second maxillae very stout and short, covered with armed padded areas; basal plate broad with teeth blunt, anterior pair of postmaxillary spines short and truncate, located on a large pad, posterior pair slender and blunt.

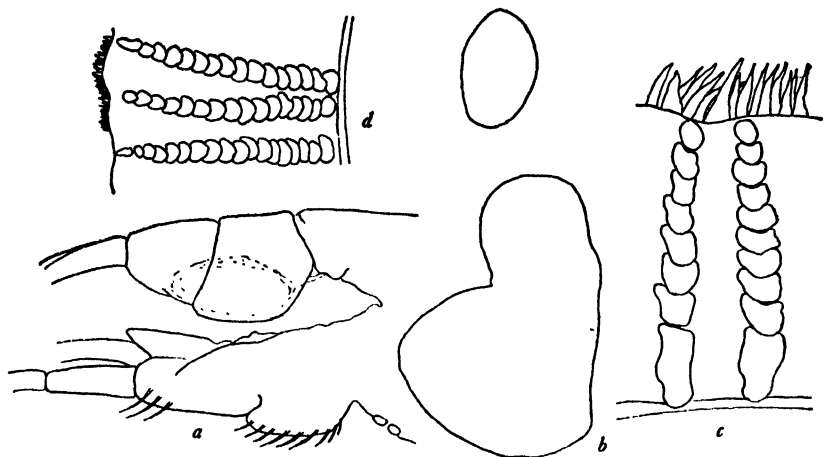


FIGURE 28.—*Argulus pugettensis*: *a*, Male accessory organs of third and fourth legs; *b*, respiratory areas; *c*, ribs of suction cups (male); *d*, ribs of suction cups (female).

Swimming appendages bearing flagella; boot-shaped natatory lobes of fourth pair very stout on female. Precoxa of male elongated on first three appendages; basal segment of second appendages unusually wide with a groove on the posterior surface, where it fits against the next appendage. On the third appendage a thin-walled voluminous sac extends the length of the coxa and part of the basis. Dorsally the opening of the socket extends about two-thirds the length of the sac. The fourth appendage has a boot-shaped natatory lobe posteriorly, and the usual chitinous ridge along the proximal side of the base of the peg. The peg is odd in that it is composed of a triangular lamina with the tip directed laterally and the base quite broad (fig. 28, *a*).

This is the only species studied where the ribs on the rim of the suction cups show any considerable sex differences. The female has been reported up to 18 mm. and the male 8 mm. This large difference

in size may account for the difference in the structure of the ribs of the suction cups. As far as can be determined *niger* is identical in every respect.

All specimens have been taken on the Pacific coast. They have been found free swimming and on the surf perch, blue perch (*Taeniotoca lateralis*), *Salmo irideus*, *Oncorhynchus kisutch*, *Hyperprosopon argeneus*, and *Cymatogaster aggregatus*.

ARGULUS FLORIDENSIS, new species

FIGURE 29

A single male specimen labeled *A. pugettensis* and found in U.S.N.M. vial No. 77810 is entirely different from typical *pugettensis* and will therefore be given a new name. It was collected by A. E. Verrill in 1884 at Key West, Fla. The host is not given.

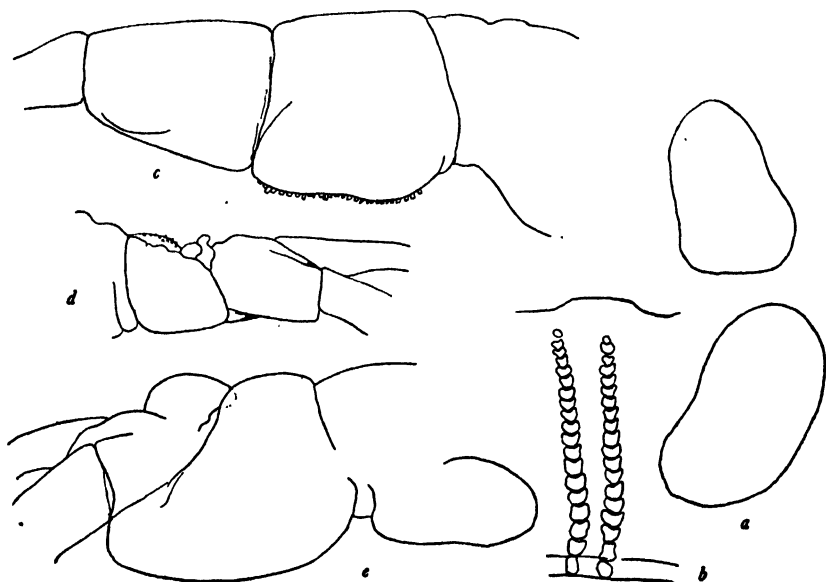


FIGURE 29.—*Argulus floridensis*: a, Respiratory areas; b, ribs of suction cups; c, second thoracic appendage (male); d, third thoracic appendage (male); e, fourth thoracic appendage (male).

Although the specimen is in poor condition, the following measurements were taken: Total length 5.85 mm., length of carapace 4.88 mm., width 4.28 mm., sinus 1.99 mm., abdomen 1.58 mm. long and 1.35 mm. wide with the anal sinus 0.98 mm.

The carapace is ovate, sinuses shallow, cephalic areas broad, eyes small, widely separated; alae reaching abdomen. Abdomen ovate, narrower at the top near the thorax, sinus deep, tips divergent, anal furcae small and basal. Dorsal ridges very stout, bowed inward

behind the eyes and diverging ahead of them. Respiratory areas well separated, almost equal in size and shape (fig. 29, *a*).

First antennae with an anterior hook; ventral mesial spine fairly large, basal spine of first antennae very large, spine on second antenna long and broad and postantennal spine very broad. These differ from *pugettensis* in that the spines at the base of the first antennae and near the midline are so very broad and the anterior hook is placed so far laterally on the lateral hook.

Suction cups about one-fifth the width of the carapace, with 18 or 19 imbricate plates in the ribs (fig. 29, *b*). This is very similar to the female *pugettensis*. Second maxillae slenderer and without so prominent spinous pads, with three broad blunt teeth, median one slightly broader than the other two, postmaxillary spines fairly long, both pairs pointing medially.

Swimming appendages without flagella. Second appendage with broadly bilobed lamella on posterior ventral edge (fig. 29, *c*). Third appendages with the dorsoanterior edge of coxa rounded proximally and armed with spines, ventral distal edge with an upright fingerlike papilla projecting anteriorly and a rounded papilla dorsal to it (fig. 29, *d*). On the fourth appendage there is a small rounded lamella on the posterior surface of the basis and a more broadly rounded blade-like lamella on the posterior surface of the coxa. The usual chitinous ridge extends obliquely across the basal segment with the peg originating on the dorsal distal end of the last basal segment and curved medially above this basal part like a curved finger (fig. 29, *e*).

There seems to be no indication of the socket from the ventral side of the animal, but on the dorsal side of the third appendage it may be seen as a saddled-shaped depression on the distal end of the basis, while the two rami are fused at their point of origin to form a broad base. This armature, the absence of flagella on the swimming appendages, and the two very nearly equal respiratory areas are all different from those of *pugettensis*.

ARGULUS BOREALIS Wilson

FIGURE 30

Argulus borealis WILSON, 1912a, p. 85, pl. 3.

Carapace slightly longer than wide, ovate; cephalic area prominent, eyes fairly large, alae reaching third appendages in female, fourth appendages in male. Abdomen elliptical; anal sinus shallow; anal furcae basal, tips diverging, testes extending almost full length of abdomen. Color almost lacking in the body except a brown band extending posteriorly from the edge of the cephalic areas paralleling the edge of the alae; dorsal surface of abdomen somewhat rusty in female; brown color on each side of testes in male. The respiratory

areas are composed of an oblong one anteriorly near the base of the second maxillae and smaller than the other, which is some distance posterior to it (fig. 30, *a*). The females measure to 8.5 mm. and the males to 4 mm. The hosts are *Lepidopsetta bilineata* and *Cymatogaster aggregatus* from Departure Bay, British Columbia.

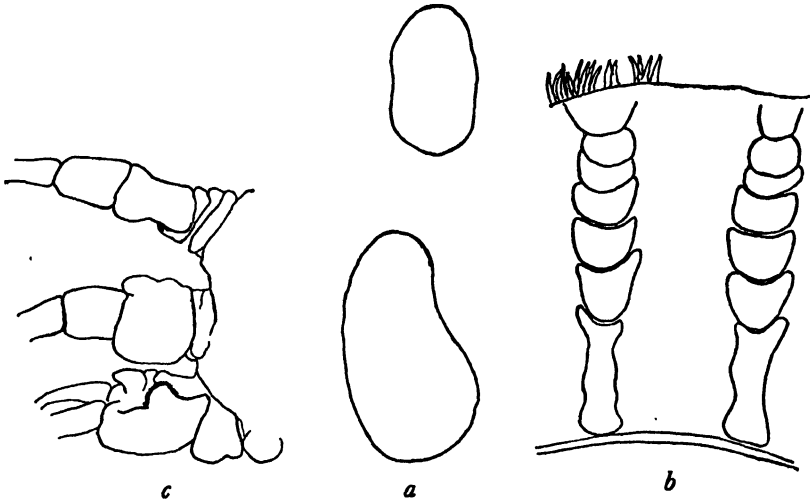


FIGURE 30.—*Argulus borealis*: *a*, Respiratory areas; *b*, ribs of suction cups; *c*, accessory organs of second, third, and fourth legs.

Suction cups with the rims supported by ribs composed of an elongate rod and four to six overlapping plates (fig. 30, *b*). Marginal lappets delicate. Second maxillae with a wide basal plate, teeth long and pointed; postmaxillary spines also long.

Antennae very trim; spines narrow, lateral hook sharp, anterior knob slender, ventral median spine prominent, spines at the base of the antennae and near midventral line long. Flagellum of first antennae longer than the lateral hook; second antennae extending almost to the edge of carapace.

Thoracic appendages without flagella. The posterior surface of the fourth appendage of the female with a somewhat bilobed fleshy prolongation of the coxa. Second appendage of male with a slight ventral posterior lobe (fig. 30, *c*). Third pair with an anterior rounded swelling on the coxa and a broadening of the same segment posteriorly where the socket is located. There is a posterior bilobed natatory flap on the coxa of the fourth appendages; the basal segments of the appendage are short and broad, with a ridge around the base of the peg on the distal anterior edge of the basis. The peg is a large, round prominence near the base of the exopod with a concavity around it. There is a bulbous papilla at the posterior end of the thorax near the male opening.

ARGULUS MEGALOPS Smith

FIGURE 31

Argulus megalops SMITH, 1873, p. 575.—WILSON, 1902, p. 706, pls. 11, 26; 1932, p. 16, fig. 5.

Argulus varians BERE, 1936, p. 579, pl. 1, figs. 11–16.

Carapace elliptical, male more rounded, in most instances reaching third appendages on both sexes, but on Florida specimens it may extend onto abdomen; cephalic area prominent, eyes large, well separated; posterior sinus broad, alae rounded; last segment of thorax broadened laterally, almost as wide as abdomen. Abdomen of female subtriangular, sinus shallow; male elliptical, connected to thorax by a narrow neck, almost as long as female, sinus shallower, anal furcae basal. The respiratory areas well separated, anterior one comparatively large, posterior with lobed margin (fig. 31, *b*). Female up to 7 mm. in length and male the same size. U.S.N.M. No. 60462, labeled *A. megalops* var. *spinosus*, is apparently not different from the regular species, except that there is less color and the spines on the ventral surface of the carapace show up better. Both have a very spinose under surface. Specimens labeled *A. varians* in the Bass Biological Laboratory differ only in a considerable variation of the size of the carapace. Other characters are identical.

Antennae slender, spines and hooks slender, lateral hook short, curved back on itself sharply, anterior knob long, with slight hook; spine on ventral surface of hook long and curved; slender spines present at base of first and second antennae and at midline; second antennae reaching almost to edge of carapace, many setae at each joint and on tip.

Suction cups small, separated somewhat, rim supported by ribs made up of an elongate rod and four to nine apparently imbricate plates (fig. 31, *a*). Second maxillae with broad basal plate having three slender widely spaced teeth; two postmaxillary pairs also slender.

Swimming appendages without flagella. Female with slender boot-shaped lobe with a broad heel and slender toe on posterior surface of fourth appendage. This varies somewhat in size. Tactile papillae slender and small.

Male third appendage with a fingerlike projection on the dorsal anterior distal edge of the coxa pointing anterolaterally, and on the posterior surface of the same segment is a large rounded lobe con-

taining the socket (fig. 31, *c*). The fourth appendages have a posterior flap, which is squarely truncate. There is the usual chitinous ridge surrounding the base of the peg. The peg is a rounded ball on a narrower neck at the distal anterior edge of the basis. Mesial to this is a triangular flap projecting anteriorly and turned ventrally at the tip. The top of the peg seems to be faceted. There is a broad papilla at the male opening between the bases of the fourth appendages.

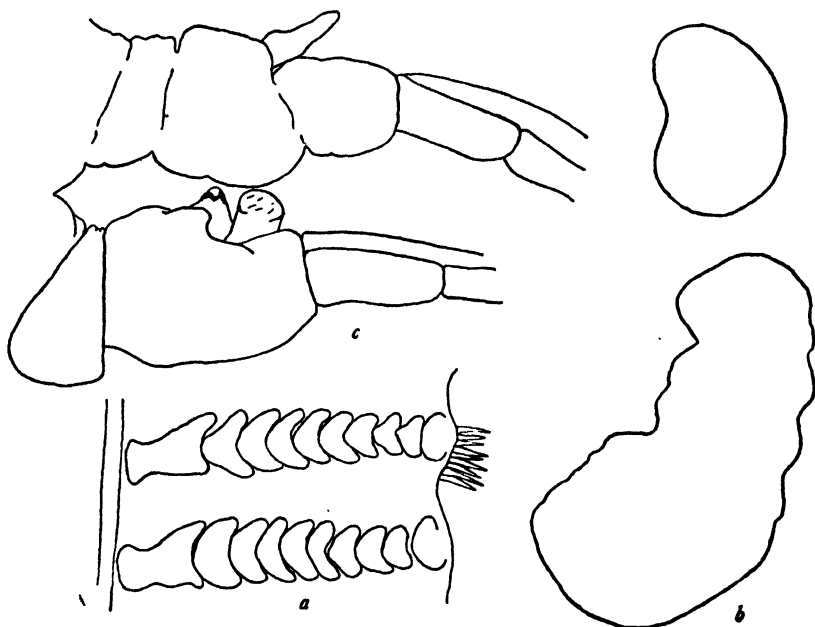


FIGURE 31.—*Argulus megalops*: *a*, Ribs of suction cups; *b*, respiratory areas; *c*, male accessory organs of third and fourth legs.

The host and localities have been reported as follows: *Myoxocephalus octodecimspinosus*, Salt Harbor, New Brunswick; *Pseudopleuronectes americanus*, *Paralichthys dentatus*, *Hippoglossoides platessoides*, *Lophopsetta maculata*, *Prionotus carolinus*, *Myoxocephalus octodecimspinosus*, *Lophius piscatorius*, *Microgadus tomcod*, and from tows in the Woods Hole region; and finally from the batfish (*Ogcocephalus* sp.), the pinfish (*Lagodon rhomboides*), the suckingfish (*Echeneis naucrates*), and the spiny toadfish (*Chilomycterus spinosus*), on the Gulf coast of Florida.

ARGULUS JAPONICUS Thiele

FIGURE 32

Argulus japonicus THIELE, 1900, p. 48; 1904, p. 39, figs. 94-98.—WILSON, 1902, p. 727.—TOKIOKA, 1936a, p. 334, pl. 21, figs. 1, 2.—YAMAGUTI, 1937, p. 781, figs. 1-9.

Argulus trilineatus WILSON, 1904, p. 651, figs. 34-38.—GUBERLET, 1928, p. 85, figs. 1-7.—MEEHEAN, 1937, pp. 288-292, pl. 1.

Carapace elliptical, covering third swimming appendages or reaching fourth; eyes well separated, cephalic area not very broad; sinuses shallow; abdomen small and spindle shaped; anal sinus deep, anal furcae basal, sides flaring on female, not on male. Anterior respiratory area small, subtriangular, posterior one large and reniform (fig. 32, *b*). The dorsal ridges are branched. Both males and females have been reported up to about 6 mm. in length.

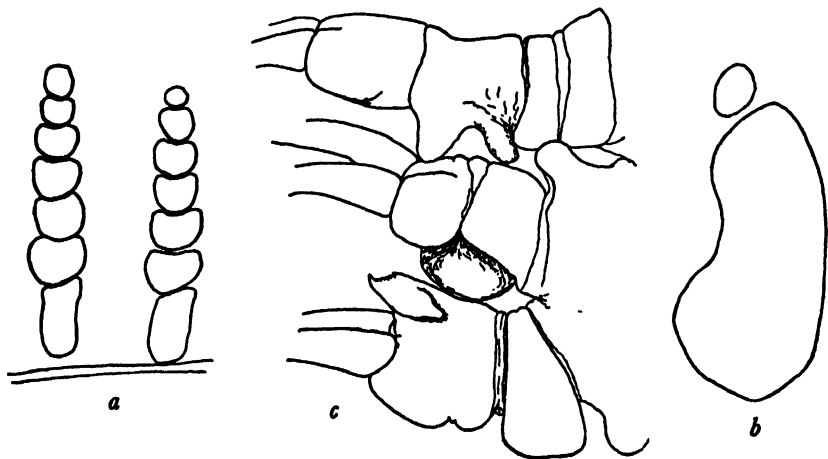


FIGURE 32.—*Argulus japonicus*: *a*, Ribs of suction cups; *b*, respiratory areas; *c*, male accessory organs of second, third, and fourth legs.

Antennae small, an anterior knob on the base of the first pair, spines at the base of both pairs and near the midline. Suction cups with an elongate basal segment and five to seven imbricate plates in the ribs (fig. 32, *a*); marginal lappets about six or seven between the ribs. Second maxillae with broad basal plate having blunt teeth widely separated; spines near midline about the same size as the teeth.

Swimming appendages with flagella, posterior surface of coxa on fourth appendage of female with fleshy rounded lobe. On the male the second appendages have a bilobed posterior protuberance with truncate spines along edge. It is placed somewhat obliquely across the coxa with the mesial lobe more dorsal and the distal portion of lobe

somewhat longer. Between the second and third swimming legs is a slight spinous lobe on the lateral edges of the thorax directed from the base of the third thoracic appendage anteriorly (fig. 32, c). On the third and fourth appendages the basal segments are only about half as long as those of the two anterior pairs. The basal segment of the third pair is very broad, and a posterior lobe containing the socket extends about two-thirds the length of the segment. The peg is composed of a chitinous shovel-shaped lobe projecting laterally from the distal end of the basis, with a fleshy protuberance directed toward the appendage on the ventral side. Around the base of the peg is the usual ridge; the basis is enlarged posteriorly and a fleshy posterior lobe is located on the coxa. There is a large papilla at the ejaculatory duct on the end of the thorax.

The host in this country is the goldfish (*Carassius auratus*), and the species has been reported from almost every region where goldfish are found.

ARGULUS LATICAUDA Smith

FIGURE 33

Argulus laticauda SMITH, 1873, p. 574.—WILSON, 1902, p. 705, pl. 10.

Carapace longer than wide, alae reaching fourth appendages of male and abdomen on female; cephalic area broad and prominent, with deep sinuses, posterior sinus broad. Abdomen orbicular, about as wide as long; sinus about one-fourth the length of carapace and broad; anal furcae basal. The respiratory areas consist of an anterior smaller one opposite the maxillae and a posterior E-shaped larger one (fig. 33, a). Females have been reported to 7 mm. and males to 6 mm.

Lateral hook of first antennae short but turned back on itself; anterior knob long with slight indication of a hook at the end; ventral spine on base of hook stout, spine at base of antenna broad with a blunt end; flagellum just reaching beyond lateral hook. Second antennae long, almost reaching the edge of the carapace; spine at base very broad, postantennal spine very broad and long.

Suction cups small, rims supported by ribs made up of three or four straight rods (fig. 33, b). Marginal lappets very large. Second maxillae with narrow basal plate flaring widely into three truncated lobes, which may be squarely cut but usually appear to be worn in the center to give a slightly bilobed appearance. Postmaxillary spines short, broad, truncated, and fairly inconspicuous.

Swimming appendages with flagella. Female with small boot-shaped natatory flap on posterior surface of coxa on fourth appendages. Male accessory apparatus extremely complicated. Precoxa of

second appendages on ventral side with a narrow chitinous strip, which projects posteriorly beyond the edge of the appendage (fig. 33, *c*). Coxa extremely broad with a broad, flat lobe along the whole posterior side, which has a machete-shaped lobe on the distal part of the appendage projecting ventrally from the posterior lobe so that it stands out from the appendage. The third appendages have the combined basal segments telescoped. Posteriorly there is a chitinous lamina projecting toward the body similar to the narrower one on the anterior appendage; it is about three times as broad as the latter. The remainder of the segments form a saddle over the fourth appendage by means of a ventral lobe on the distal end of the coxa and a dorsal lobe proximal to it. The exopod is broad at the base

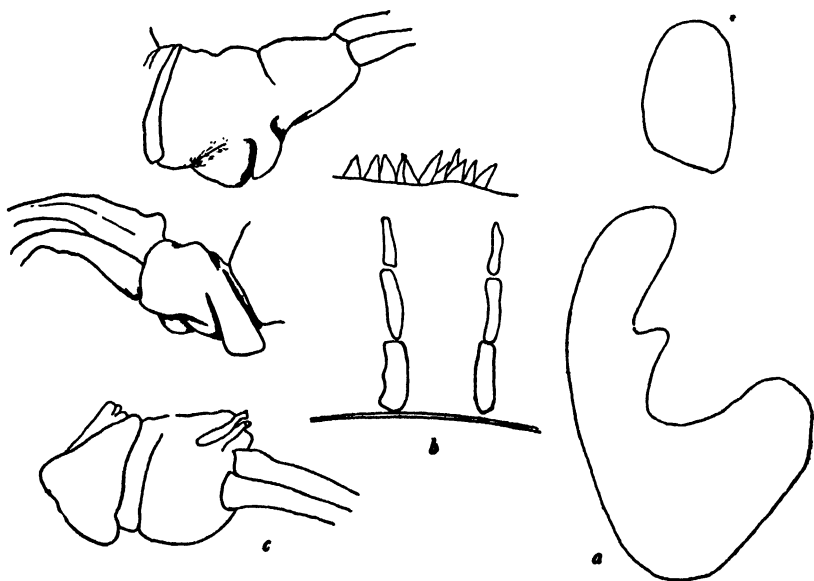


FIGURE 38.—*Argulus laticauda*: a, Respiratory areas; b, ribs of suction cups; c, accessory organs on last three legs of male.

with a large hump anteriorly which fits under the lobe of the anterior appendage. The fourth appendage also has short basal segments. Anteriorly the broad peg occupies more than half the space. It is projected out as a large papilla tipped on the distal edge by two chitinous cylindrical tips which extend down the side of the papilla. The posterior edge of the basis is expanded into a hatchet-shaped projection, while the coxa has a roughly boot-shaped one. The exopod is expanded slightly at the base.

This species has been collected in tows at Vineyard Sound, Mass.; on *Anguilla rostrata*, *Pseudopleuronectes americanus*, *Paralichthys dentatus*, *Microgadus tomcod*, *Myoxocephalus scorpius*, *Opsanus tau*,

all from the Woods Hole region; *Promicrops itaira*, Dry Tortugas; and from *Opsanus tau*, *Pteroplatea maculura*, and *Amphotistius say* in the Gulf of Mexico.

ARGULUS RETICULATUS Wilson

FIGURE 34

Argulus reticulatus WILSON, 1920b, p. 2, pl. 1.

Carapace elliptical; cephalic area slightly prominent, posterior sinus shallow and rectangular; eyes small, widely spaced; alae overlapping abdomen on female and about reaching it on the male. Abdomen ovate, anal sinus shallow and narrow. Anterior respiratory area subtriangular, posterior one very large and reniform (fig. 34, *b*).



FIGURE 34.—*Argulus reticulatus*: *a*, Rib of suction cup; *b*, respiratory area; *c*, accessory organs of second and third legs of male; *d*, fourth leg with peg.

Antennae short; anterior hook with broad base; spines present on the ventral surface of the lateral hook and at the base of the first and second antennae and near the midline of the body. The two latter somewhat stout. Suction cups with ribs composed of a series of rectangular rods, the distal one pointed (fig. 34, *a*). Maxillae slender, basal plate with three rounded teeth; first pair of maxillary spines pointed, second pair rounded.

Thoracic appendages with flagella. Second appendages of male with a bilobed protuberance on the posterior surface of the coxa. Third appendages with a large circular lobe containing the socket projecting posteriorly from the coxa, but overlapping part of the basis (fig. 34, *c*). On the fourth appendages is the usual natatory lobe on the posterior surface of the coxa. The peg is very much enlarged, but with the usual small tip. Extending along the ventral surface of the peg toward the appendages is a fleshy papilla somewhat like that on *japonicus* (fig. 34, *d*).

The female measures to 8 mm. and the male to 6 mm. The host is *Hydrocyon goliath* from the Congo River, Africa.

ARGULUS FUNDULI Krøyer

FIGURE 35

Argulus funduli KRØYER, 1863-64, p. 94, pl. 2, fig. 1.—WILSON, 1902, p. 710, pl. 14; 1932, p. 13, fig. 1.—THIEL, 1904, p. 34.

Argulus latus SMITH, 1873, p. 574.—WILSON, 1902, p. 704, pl. 9; 1932, p. 14, fig. 2.

Carapace about as wide as long; cephalic area broad and prominent; eyes large and well separated; posterior sinus broad, alae reaching third appendages on both sexes. Abdomen of male elliptical, half as wide as long, with the testes extending the full length to the sinus; female abdomen broader in proportion, with tips more widely separated; anal furcae basal. The respiratory areas are small and widely separated, somewhat circular in appearance; the anterior one ahead of the second maxillae and the posterior larger one behind the first swimming appendages (fig. 35, *b*).

The antennae are small, with a slight indication of an anterior knob; spine at base large, postantennal spines broader. Spine at base of second antennae smaller than those on first. Suction cups large, about one-third the width of the carapace; ribs in rim supported by 15 to 22 imbricate plates and a more elongate basal one (fig. 35, *a*). Marginal lappets very small. Second maxillae slender; basal plate broad and irregularly triangular, with one to three blunt teeth; the two pairs of postmaxillary spines lacking.

Swimming appendages without flagella; fourth coxa of female with a small, rounded posterior lobe, whole protopod broader than

on anterior appendages. Third appendages of male have an anterior triangular flap from the distal edge of the coxa extending over the basis; the posterior surface of the same segment is enlarged where the socket is located (fig. 35, *c*). The socket itself is merely a shallow cup with a fleshy lip around it on the posterior surface of the segment in contrast to the usual opening on the dorsal side.

The peg appears as a fingerlike lobe curled mesially, with a second lobe proximally and pressed up against it. They are both located on the dorsal side of the segment in line with the end of the exopod. There is a chitinous ridge around its base, as in other species.

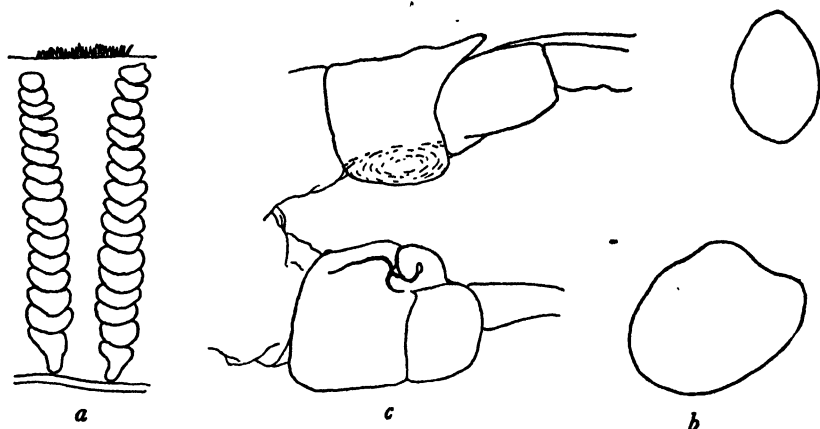


FIGURE 35.—*Argulus funduli*: *a*, Ribs of suction cups; *b*, respiratory areas; *c*, male accessory organs of third and fourth legs.

Smith's description of *A. latus* is not full enough to enable one to determine whether he has established a true species. The specimens of *A. funduli* and *A. latus* in the National Museum seem to be identical in every respect. Both have a slight lobe on the mesial side of the basal plate of the second maxillae, and they lack spines near the midline between them. They have 15 to 22 imbricate plates in the rim of the suction cups, with a slightly enlarged one at the base. The respiratory areas are similar on the two; the posterior lobe on the fourth swimming appendages of the female are alike. The antennae have a slight indication of an anterior knob on both species, with the spines at the base of the first antennae and the postantennal ones larger than the others. The carapace reaches or covers the third thoracic appendages. U.S.N.M. No. 60452 contained some immature males labeled *A. latus* along with some females. The males were immature so that the accessory copulatory apparatus was not developed far enough to tell whether there were any specific differences. It is therefore proposed that until the males are found these species be considered as synonymous.

A. latus has been taken in surface tows at Vineyard Sound, Mass., in a brackish pond on Chappaquiddick Island, Mass., and in Casco Bay, Maine.

A. funduli was described from specimens taken on *Fundulus ocellaris* near New Orleans, La.; others from many fish at Waquott Hole and Woods Hole, Mass., and Long Island Sound; from *Fundulus majalis* at Beaufort, N. C.; *Fundulus heteroclitus*, St. Andrews, New Brunswick; a brackish pool at Meveitta, Fla.; on *Menidia notata* and *Pseudopleuronectes americanus* from the Passamaquoddy region; and on *Lagodon rhomboides* from the Gulf of Mexico. The females measure to 5 mm. and the males to 4 mm.

ARGULUS VIOLACEUS Thomsen

FIGURE 36

Argulus violaceus THOMSEN, 1925, p. 185, figs. 1-15.

Carapace elliptical, covering second appendages on female and reaching third ones on male; posterior sinus broad, eyes widely separated; cephalic area prominent and sinuses deep. Abdomen of male subtriangular, with broadest portion near anterior end; almost rectangular on female, with narrow neck attached to thorax; sinus broad, uniform in width, anal furcae basal, rounded. The testes extend almost the full length of the abdomen.

Antennae arranged to accommodate them to the narrowness of the cephalic area. The lateral hook is pushed forward and bends back very far; anterior hook pushed mesially, very broad at base and long with a minute hook. A large spine located on the ventral surface of the lateral hook, spine at base of second antenna long and blunt, that at base of the first is broader and those near the midline very broad and blunt. Second antennae extending to the edge of the carapace.

Suction cups small and widely separated. Rim narrow with ribs composed of a somewhat J-shaped basal rod and an oblong distal one, marginal lappets blunt and rounded (fig. 36, *a*). Second maxillae slender, basal plate with three broad rounded lobes, and both pairs of spines near the midline rounded with spinous pads on them. Anterior respiratory area subtriangular located near suction cups, with the posterior one extending to the end of the alae (fig. 36, *b*).

Thoracic appendages with flagella, very stout and short on the female; thorax slightly widened between third and fourth pairs; on the male the coxa is slightly broader than the width of the second appendage. The third appendages are peculiar in that the basal

segments are only as long as the coxa of the second one; coxa with a bilobed papilla on the anterior surface; basis short and unmodified. The first segment of the endopod is very broad, with a spine in the middle of the ventral surface and a longer sharper one on the anterior distal surface at the base of the distal segment. The distal segment is curved, with long curved setae that fold over from both edges, which are peculiar in that they bend toward the posterior of the segment and are found on both edges instead of only one as in other species. The exopod originates on the dorsal surface of the basis and curves laterally reaching to the middle of the distal segment of the endopod. The socket can be seen from the dorsal side as a lobe rounded posteriorly from the coxa (fig. 36, c).

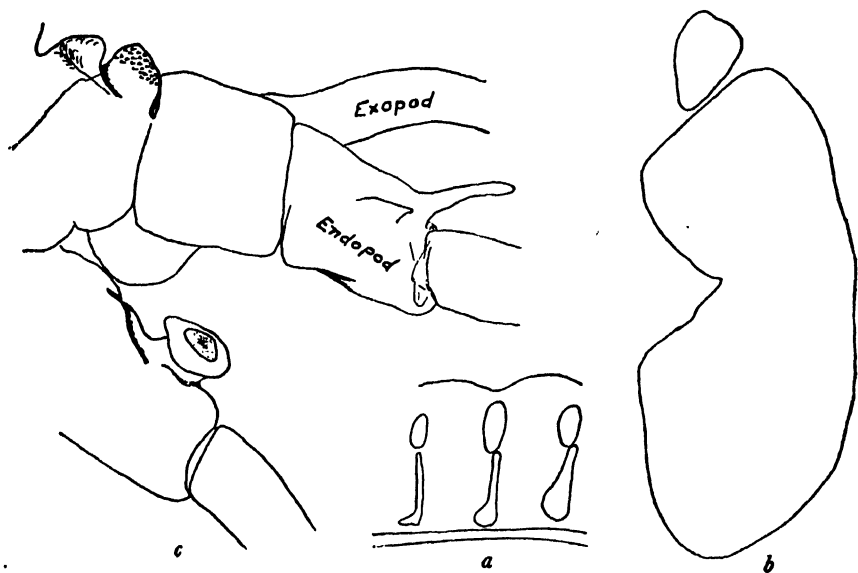


FIGURE 36.—*Argulus violaceus*: a, Ribs of suction cups; b, respiratory areas; c, accessory organs of third and fourth legs of male.

The fourth appendages have a slight rounded lobe on the posterior of the coxa. Anteriorly there is a slight indication of a chitinous ridge around the base of the peg. The peg is a mounded, button-shaped, chitinous papilla, with a slight concavity on the top. The exopod originates on the dorsal side of the basis as on the third appendages, with a triangular flap over the peg, as seen from the dorsal side. The basal segments of the fourth appendages are covered by the abdomen.

The female is 6.5 mm. and male 5 mm. The hosts are *Pledostomus commersonii* from Uruguay and *Rhamdia quelea*.

ARGULUS SALMINI Kreyer

FIGURE 37

Argulus salminet KREYER, 1863-64, p. 89, pl. 1, fig. 1.

Argulus paulensis WILSON, 1924, p. 4, pl. 1, figs. 1-5.

Carapace wider than long, reaching third appendages on male and overlapping them on the female. Cephalic area prominent, sinuses shallow. Eyes light colored and widely separated; dorsal ridges divergent anteriorly, extending very far anteriorly toward the edge of the carapace. Abdomen of female wider than long, anal sinus one-fourth the length, seminal receptacles large; male abdomen longer than wide, anal sinus very shallow and broad, testes occupying most of the available space; anal furnace basal, elongate.

Antennae slender, slight knob on anterior of lateral hook, which is bent in an arc, distal end of flagellum opposed by a prominent seta; second antennae so slender that the basal segments grade into the distal ones, spines slight, chitinous protuberances almost absent at base of second antennae but larger on ventral of first antennae and at base and near midline of the body. There is not so great a differentiation of the segments of the antennae as in other species.

Suction cups with narrow rims, supporting ribs tapered and broken into 9 or 10 segments, marginal lappets numerous between the ribs (fig. 37, *c*). Second maxillae with broad basal plate slightly lobed, medial lobe somewhat longer and narrower; two pairs of postmaxillary spines conspicuous or not, but present at least as chitinous prominences.

Swimming appendages with flagella, which are very stout on the female and tipped with very long setae. Appendages of female normal, with a small, boot-shaped, natatory lobe on fourth. Second swimming appendage of male has the usual posterior bilobed lamella but with the proximal lobe abbreviated and the distal one elongate (fig. 37, *a*). The lobe enclosing the socket on the posterior of the third appendage is located dorsally over the groove dividing the basis and coxa, so that the location of the socket cannot be noted from a ventral view, because the opening is on the segment proper rather than on the lobe. The peg is a triangular prolongation of the anterior edge of the basis ending in a number of points; dorsally the end is an oddly shaped movable hook with a flat surface underneath. On the ventral surface of the peg is a fleshy papilla projecting medially much as in *japonicus*. The coxa has a small, boot-shaped, natatory lobe posteriorly, well armed with long setae. There is a broad papilla near the male opening.

The respiratory areas are composed of an anterior subtriangular smaller one and a posterior large one with a notch in the middle of

the mesial side (fig. 37, *b*). The females measure up to 8 mm. and the males to about half that size. The host is the "Italrirana" in Brazil. It is a fresh-water species.

Thiele (1904) showed a pair of spinous prominences on the anterior surface of the basis on the third swimming appendage. The specimens at hand have one prominent one on the dorsal side of this appendage, with the rest of the anterior appendage rounded to fit under the lobe or pad projecting from the posterior surface of the second appendage.

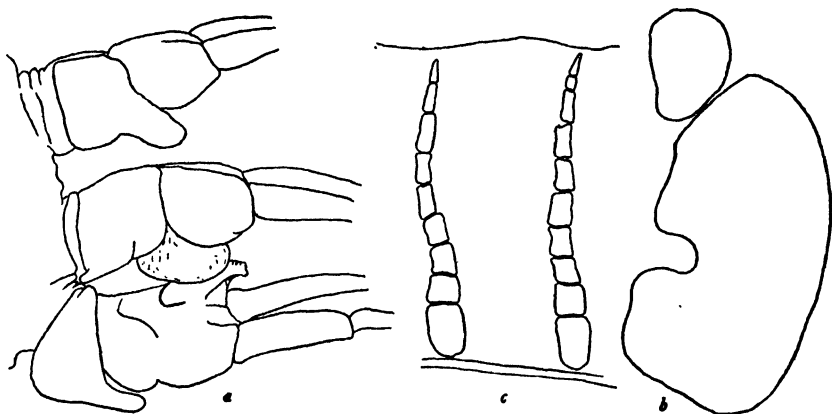


FIGURE 37.—*Argulus salminei*: *a*, Accessory organs of last three legs of male; *b*, respiratory areas; *c*, ribs of suction cups.

On the dorsal side the base of the coxa projects posteriorly as a rounded prominence, so that from a ventral view the tip appears as a spinous pad median to the rounded voluminous swelling enclosing the socket. The opening of the socket is an oblong slit, which is very long to correspond to the size of the large pad.

Two specimens labeled *A. nattereri* (Heller), No. 1261-91/435, are identical with *A. paulensis* Wilson. The largest of these was 10.4 mm. long. They do not fit Thiele's description of the type for *nattereri* in two particulars—the anterior protuberance on the first antenna is a knob rather than a hook, and the teeth on the basal plate of the maxillae are short and broadly rounded rather than long and slender.

Both groups of specimens seem to fit the description of *A. salminei* Krøyer, as given by Thiele, in every detail except one. He says that there are about seven segments in the ribs of the suction cups. The two groups in the Museum have about 16, and 9 or 10, respectively. Since these divisions are somewhat dependent upon the size of the animal and are the same in shape, the number of segments is not significant. The male accessory appendages of *paulensis* and *salminei* are alike. The former therefore becomes synonymous with the latter,

and the specimens labeled *nattereri* are really the same as these. No respiratory areas have been figured for any of these. They are, however, included in the present description.

ARGULUS AMERICANUS Wilson

FIGURE 38

Argulus americanus WILSON, 1902, p. 718, pl. 21, pl. 26, figs. 84-86; 1904, p. 627, figs. 1-21.

Carapace about as wide as long, overlapping the abdomen in both sexes, alae overlapping thorax and truncate on large females; cephalic area prominent, sinuses not deep. Abdomen subtriangular, about as wide as or wider anteriorly than the length; sinus one-fifth to one-fourth length of abdomen, sides diverging, anal furcae subterminal and large. The respiratory areas are peculiar in that the

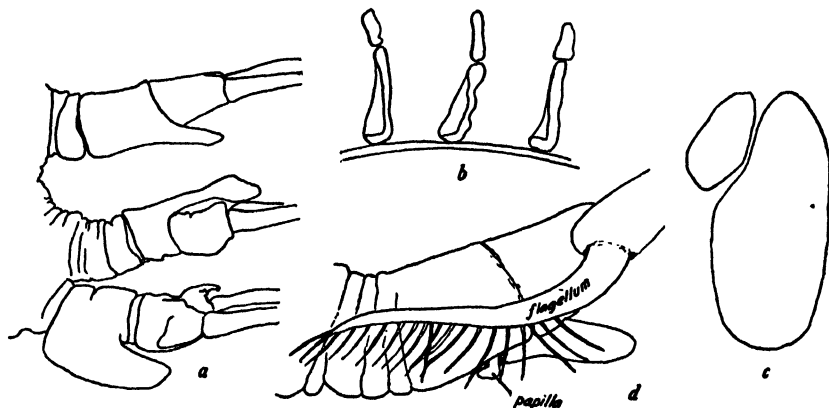


FIGURE 38.—*Argulus americanus*: a, Male accessory organs of last three legs; b, ribs of suction cups; c, respiratory areas; d, dorsal view of second male appendage.

smaller is oblong and located in a notch in the larger one, mesially and anterior to it (fig. 38, c). Females have been reported up to 12 mm. and males of about the same size.

Antennae deeply sunk into carapace, very characteristic since bases of first antennae are usually prolonged mesially into a knob; there is an extra spine between that at the base of the first antennae and the postantennal spine, making three pairs in a row. The lateral hook is bent posteriorly; base of segment enlarged into an anterior knob, rather than the usual more mesial one; ventral spine large; second antennae with large spine at the base; basal segments not very large, others progressively smaller and armed with setae.

Suction cups with rims supported by ribs composed of two or three elongate rods, interior ones longer than outer (fig. 38, b). Second

maxillae about normal, basal plate with the two mesial teeth more pointed than lateral broad one; postmaxillary spines blunt and rounded.

Swimming appendages with flagella. Female with boot-shaped lobe on posterior surface of fourth coxa; tactile papillae long and stout. Second appendage of male with a lobe on the posterior surface of the coxa prolonged laterally almost as long as the basis, a short flagellumlike papilla on the middle posterior surface of the coxa underneath the posterior ventral lobe (fig. 38, *d*). Third appendage with a club-shaped lobe on the anterior distal edge of the coxa extending over the basis to the exopod; on the posterior surface of the basis is a flat lobe with the socket opening on its dorsal surface (fig. 38, *a*). The peg, with an armed ridge around its base, is located on the basis of the fourth appendage; the posterior boot-shaped lobe extends laterally about to the distal end of the basis and is covered entirely by the abdomen.

From the host *Amia calva* it has been reported from Ann Arbor, Mich.; Lake Maxinkuckee and Kankakee River, Ind.; Fairport, Iowa; from *Umbra limi* at Fairport, Iowa; from *Amia calva*, Ocean Pond, Lake City, Fla.; and from *Esox nobilior*, Clayton, N. Y.

Approximately one-third of the type specimens of *americanus*, U.S.N.M. No. 20940, are spotted like *maculosus*. In the same way many specimens of the latter are unspotted, so that the color is not a specific character.

ARGULUS VERSICOLOR Wilson

FIGURE 39

Argulus versicolor WILSON, 1902, p. 716, pl. 20, pl. 26, fig. 83; 1904, p. 643, figs. 22-33.

Carapace only slightly longer than wide, alae overlapping abdomen slightly on the male and just reaching it on the female; cephalic area prominent, lateral sinuses not deep. Abdomen ovate in female, subtriangular in male; anal sinus very shallow, furcae subterminal and fairly large. Distinctive dark coloring along depressions in alae and posterior of cephalic areas, between dorsal ridges and along intestinal tract through abdomen. Wilson states that these are variegated in natural color. Smaller respiratory area rounded and located in a notch on the mesial side of the larger one (fig. 39, *a*). Females are reported up to 6 mm., males to 4.5 mm. The hosts and localities are as follows: *Esox reticularis*, Warren and Worcester, Mass.; Patapsco Relay, Md.; Lake Maxinkuckee, Ind.; "pickerel," Valdosta, Ga.

First antennae with anterior knob, broad ventral spine, and large spine at base; second antennae with broad spine at base; broad post-

antennal spine and an extra one between that and the one at the base of the first antennae, making three in a row.

Suction cups have ribs made up of an oblong basal plate and two to four somewhat oblong shorter ones (fig. 39, *b*). These differ from *maculosus* in that the distal plates are oblong rather than rectangular and the basal plate is long and narrow without a broad base. The second maxillae have long widely spaced teeth, with the two pairs of spines near the midline of the body stout and long, the posterior pair very near the basal plate. These teeth are slenderer than in *maculosus*.

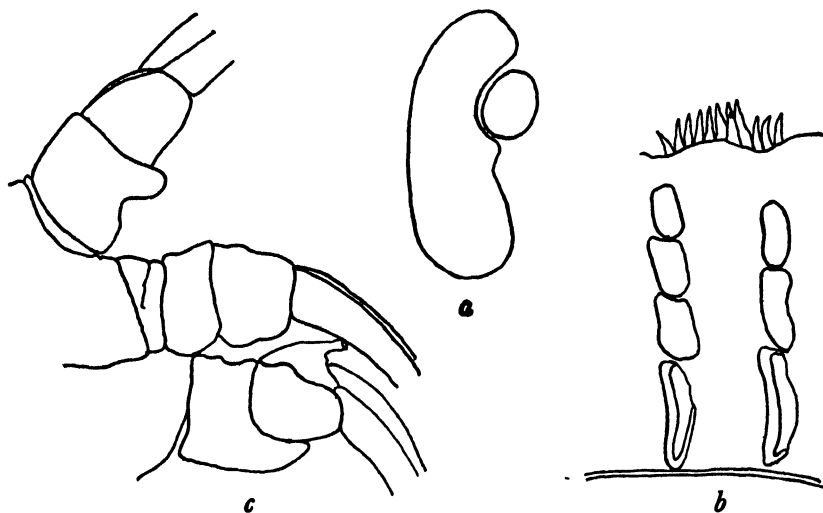


FIGURE 39.—*Argulus versicolor*: *a*, Respiratory areas; *b*, ribs of suction cups; *c*, male accessory organs of last three legs.

Flagella are present on the swimming legs. There is a slight lamella on the posterior of the coxa of the third appendages of the female; the usual natatory lobe on the posterior of the fourth appendage but without a heel; large females may have a lamella on the basis also, tactile papillae very long.

On the male the second appendages have the usual bilobed pad on the posterior ventral side of the coxa armed with short spines (fig. 39, *c*). On the third appendages there is a lamella on the posterior surface of the basis, with a rounded lobe on the coxa that accommodates the socket. Dorsally there is a large rounded papilla on this segment, with a groove running posteriorly to the opening of the socket. The fourth legs of the male have a posterior lamella expanded somewhat laterally over the basis. Anteriorly there is the usual chitinous ridge medially around the base of the peg, while the peg itself is pear-shaped, with a broad base and narrow tip projected

laterally. The exopods are distinguished from those of other species by being dark in contrast to the endopods.

ARGULUS MACULOSUS Wilson

FIGURE 40

Argulus maculosus WILSON, 1902, p. 715, pl. 19, pl. 26, fig. 82; 1907, p. 416, pl. 31, figs. 15-22; 1914, p. 354.

Carapace about as wide as long; sinuses sharp but not deep, alae reaching or covering third appendages; abdomen on male almost rectangular, but subtriangular on female; anal sinus fairly deep, with sides flaring somewhat. Tactile papillae very prominent. The respiratory areas consist of a small one in a notch on the mesial side of the larger (fig. 40, *a*).

Antennae with three spines along the midline, the posterior one broader and longer. There is an anterior hook on first antennae as compared with a knob on *americanus*, but the knob on proximal edge of basal segment of first antennae is not so prominent. There is a slight papilla above spine at base of second antennae. Suction cups supported by ribs composed of three to eight rods, as compared with two in *americanus* (fig. 40, *b*). Basal plate of second maxillae with long teeth, plate narrow, postmaxillary spines long.

Swimming appendages with flagella; fourth appendage of female with boot-shaped lobe with broad heel, extending beyond the abdomen; third appendages with slight posterior ridge, precoxae long, especially on male. Second thoracic appendages of male with the usual posterior lobe but extended laterally (fig. 40, *c*). It does not have the papilla under it that is found in *americanus*. Third appendage with anterior flap on coxa extending over basis; basis expanded posteriorly with socket. The peg is very broad at the base extending over the whole anterior surface of the basis; the tip is unusually large and turned somewhat anteriorly. The posterior lobe of the coxa is extended laterally around the basis.

There is considerable similarity between *americanus* and *maculosus* and between the females of *versicolor* and the other two. *A. maculosus* can be separated from *americanus* by the following points of difference: On the former the rounded anterior respiratory area is small and mesial, but on the latter it is large and at the antero-mesial corner of the larger, more posterior one. The former has an anterior hook on the first antennae, while on the latter there is a knob. On *maculosus* the third spines at the midline near the antennae are longer and larger, and the mesial knob at the base of the first antennae is not very prominent. There are four to six rods in the sucking disks of *maculosus* and only two in *americanus*. The

teeth on the basal plate of the maxillae of *maculosus* are long compared with a lateral broad one in *americanus*; the extra flagellum-like papilla under the posterior lobe on the second thoracic appendages of the male of *americanus* is missing in *maculosus*.

A. versicolor differs from *americanus* in that it has respiratory areas like those in *maculosus*. It has an anterior knob on the antennae instead of the anterior hook, and the teeth of the basal plate on the second maxillae are slender.

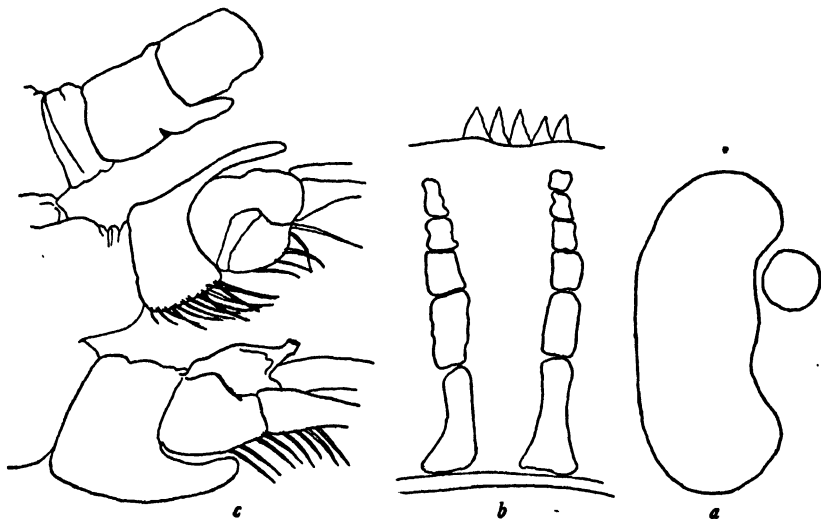


FIGURE 40.—*Argulus maculosus*: a, Respiratory areas; b, ribs of suction cups; c, male accessory organs of last three legs.

It differs from *maculosus* in that the three spines at the base of the antennae are about the same size. The rods in the ribs of the suction cups are composed of a narrow elongate basal and distal oblong segments as compared with a broad basal and rectangular distal segments on *maculosus*. The teeth on the second maxillae are very slender and widely spaced as compared with the closely spaced ones on *maculosus*. The male accessory apparatus is entirely different and characteristic.

This species has been reported from *Ameiurus nebulosus*, *A. natalis*, and *Ambloplites rupestris* from Lake Maxinkuckee, Ind.; and from *Ameiurus natalis*, Lost Lake, Ind. Females measure to 10 mm. and males to 7 mm. in length. This species also occurred in a collection sent me by Dr. Bangham from Woodmere, Fla., on the chub sucker (*Erimyzon sucetta*).

The type specimens for *maculosus*, U. S. N. M. No. 28937, are typical *americanus*, as well as No. 12226. Judged from Wilson's

description and figures (1902, pp. 715-716, pl. 19), he seems to have separated the species according to the presence or absence of pigment spots. On about one-third of the types of *americanus* one may note the typical flecks that he indicates as characteristic of *maculosus*. The remaining vials do contain specimens with the characters outlined above, some of which may be designated as types for the species. There is no such specimen as that from which he described the species and which was probably aberrant.

ARGULUS MISSISSIPPIENSIS Wilson

FIGURE 41

Argulus mississippiensis WILSON, 1916, p. 350, pl. 61, figs. 13-15; pl. 62, fig. 21; pl. 63.

Carapace subcircular, wider than long, alae somewhat truncate posteriorly so that lobes just about reach abdomen; eyes small and widely separated; abdomen one-fourth the total length of the body,

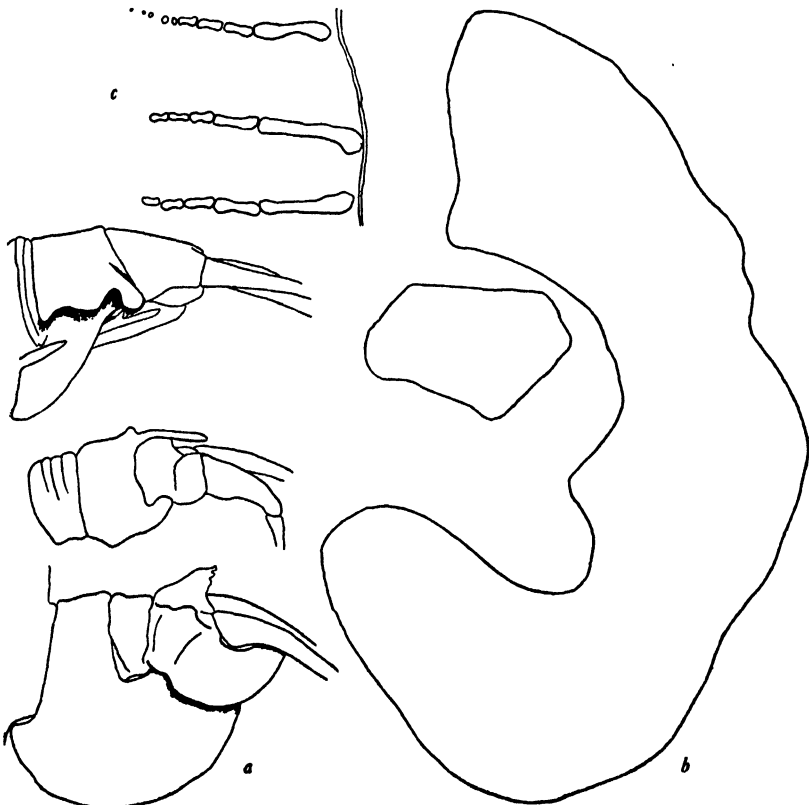


FIGURE 41.—*Argulus mississippiensis*: a, Accessory organs of last three legs of male; b, respiratory areas; c, ribs of suction cups.

roughly rectangular in shape; anal sinus deep, sides flaring on female and in contact on male, lobes pointed with anal furcae simulating a second more median tip to the lobes of the abdomen; anterior end of abdomen square. The whole effect of the animal is very flattened and leaflike, flecked with brown.

The lateral hook on the antennae is curved in an arc instead of being more sharply bent; anterior hook curved as well as the spine on the midventral surface of the hook. Spine at base of first antennae small, those near midline of body larger, all sharp. Tip of first antennae biramous, second antennae short.

Suction cups small, edge supported by ribs composed of three or four rods, with slight indications of others; about four triangular lappets on the edge of the disk between the ribs (fig. 41, *c*). Second maxillae short and stout, basal plate with sharp teeth; anterior pair of postmaxillary spines very small, posterior pair hardly discernible or lacking.

Swimming appendages with flagella on the two anterior pairs. Each of the first three pairs on the female with posterior ventral ridges or lobes on the coxa progressively larger toward the third one. Fourth appendage with a broadly rounded lamella on both the coxa and basis. Tactile papillae fairly large.

First swimming appendage of the male with a slight ridge across the posterior ventral edge of the coxa. Second appendage with a broad irregular lobe on posterior edge of coxa with distal edge longer. On the dorsal side the posterior edge of the coxa is prolonged into a machete-shaped flap directed toward the body over the base of the third appendages (fig. 41, *a*).

The third appendages have the precoxa somewhat enlarged; posterior ventral edge of the coxa lobed, with the distal edge prolonged laterally over the basis and the anterior distal edge prolonged as a flap over it. The toe of the posterior lobe covers the broadened portion of the basis, which contains the socket. There is a slight knob on the distal anterior end of the endopod.

There are two posterior lamellae on the fourth appendages similar to those of the female. The peg is very stout but ends in a narrow curved tip with a blade-shaped chitinous process under the tip. It is surrounded with a chitinous ridge, as in other species. The smaller rounded respiratory area fits into a concavity in the side of the semilunar large one that extends to the second maxillae (fig. 41, *b*).

The females have been reported to 19 mm. and the males to 12.5 mm. *A. mississippiensis* is about as large as *A. nobilis* but very much more flattened and expanded. The hosts are *Lepisosteus osseus* and *Cylindrosteus platostomus* from Fairport, Iowa.

ARGULUS CATOSTOMI Dana and Herrick

FIGURE 42

Argulus catostomi DANA and HERRICK, 1837, p. 297, pl. 1, figs. 1-11.—MILNE EDWARDS, 1840, p. 445.—THORELL, 1865, p. 60.—WILSON, 1902, p. 709, pl. 13.—THIELE, 1904, p. 25, figs. 53-58.

Carapace orbicular, usually wider than long, about reaching abdomen; abdomen relatively small, rounded, with sinus one-fifth to one-third the length. First antennae without spine at the base or on ventral surface of hook; anterior knob present, flagellum with seta opposing the distal segments; second antennae without a spine at the base, spine present near midline of body. The respiratory areas are composed of the smaller rounded one set in a notch mesially, about the middle of the larger, and about opposite the second maxillae (fig. 42, *a*). The females have been reported up to 12 mm. long and the males to 6 mm.

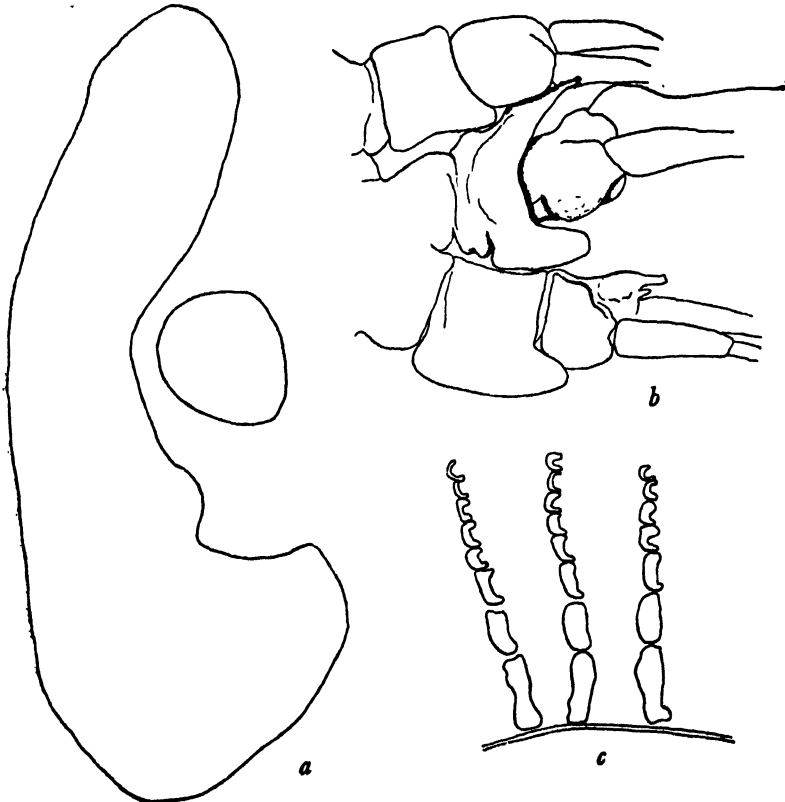


FIGURE 42.—*Argulus catostomi*: *a*, Respiratory areas; *b*, male accessory organs of last three legs; *c*, ribs of suction cups.

Suction cups supported by a series of seven to nine short rods becoming progressively smaller toward the edge of the rim, distal ones with only one side of rod thickened giving a C-shaped effect (fig. 42, *c*). Second maxillae stout, basal plate broad with three (sometimes two or four) broad stout teeth on the edge, lateral tooth stouter than others; the usual two pairs of postmaxillary spines absent.

The swimming appendages have flagella. Female with a flat lamella on the basis of the fourth appendages and a somewhat boot-shaped lamella on the coxa. There is a slight widening of the coxa of the third appendage to form a posterior ridge.

Second appendage of male has the usual posterior armored pad on coxa, which is peculiar in that it is highest on the distal end of the coxa and forms a saddle to fit over the next appendage. The third appendage has a flap on the anterior distal edge of the coxa extending over the basis to the exopod (fig. 42, *b*). From the posterior of the same segment extends a battle-ax-shaped flap over the fourth appendage and laterally over the basis covering the lobe containing the socket. The exopod has a knee at the base. The fourth appendage has the usual peg with a small prolongation to form the tip which is somewhat enlarged with a ridge around the base. The posterior surface of the coxa is prolonged into a boot-shaped flap.

This species has been taken on carp (*Cyprinus carpio*) at Fairbury, Ill.; from *Erimyzon sucetta oblongus* at Warren, Mass.; *Catostomus commersonii* at New Haven, Conn., Woods Hole, Mass., and Lake Champlain and Oneida Lake, N. Y.; and on *C. commersonii*, *C. nigricans*, and *C. catostomus* in Lake Maxinkuckee, Ind. In Connecticut and Massachusetts it was found in brackish water, but in fresh water elsewhere.

ARGULUS APPENDICULOSUS Wilson

FIGURE 43

Argulus appendiculosus WILSON, 1907, p. 419, pl. 32, figs. 23-30.

Argulus biramosus BEEBE, 1931, p. 428, figs. 1-7.

Carapace slightly longer than wide, reaching abdomen in male, shorter on female; cephalic area not prominent. Abdomen spindle-shaped, lobes pointed; anal furcae almost basal, diverging laterally and truncated; sinus about half the length of the abdomen. The respiratory areas consist of a small mesial rounded one fitted into a notch in the larger lateral one (fig. 43, *b*). The male has been reported up to about 10 mm. in length and the female considerably larger.

First antennae with no anterior knob, no spine on ventral median surface or at base; flagellum biramous. Second antennae with no spine at base, spine near midline long and blunt, flagellum well sup-

plied with setae. Suction cups about one-fifth width of carapace, rim supported by ribs with two segments, edge with truncated lobes armed with delicate setae as opposed to triangular lobes of other species (fig. 43, *a*). Second maxillae with blunt teeth and two pairs of blunt post-maxillary spines near midline.

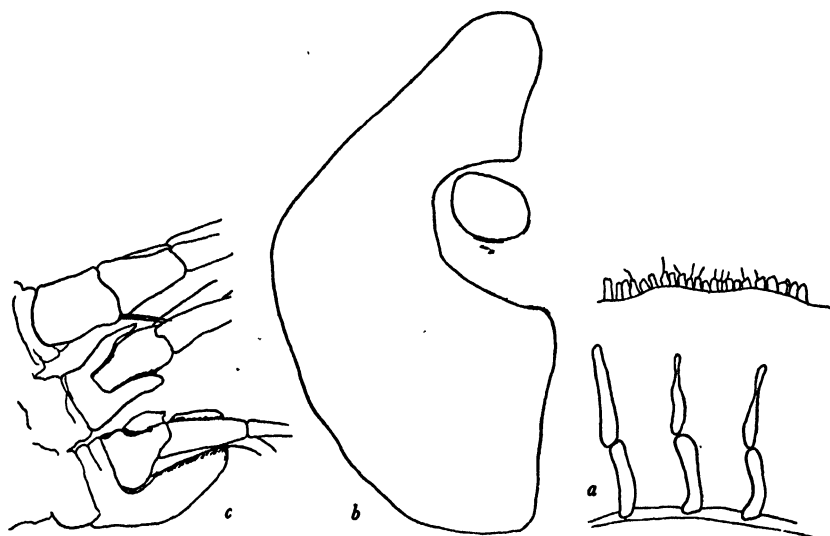


FIGURE 43.—*Argulus appendiculosus*: *a*, Ribs of suction cups; *b*, respiratory areas; *c*, male accessory organs of last three legs.

Swimming appendages with flagella, female with boot-shaped lamella posteriorly, which extends beyond the margin of the abdomen; on the male the lamella is prolonged and turned anteriorly so that the end is parallel with the anterior edge of the fourth appendages. The second appendage of the male has a broad lobe on the posterior ventral edge of the coxa, which is slightly prolonged laterally with long setae on it (fig. 43, *c*). On the third appendage the coxa has a triangular lamella extending over the basis and a posterior one also projecting laterally. The posterior surface of the basis beneath the lateral lobe of the posterior lamella is slightly enlarged to accommodate the socket with its opening directed dorsally. The basal joint of the endopod of the fourth appendage is broad and the terminal joint abbreviated on most mature males. The peg consists of a typical pear-shaped organ with a narrow tip directed laterally; around the base is the usual chitinous ridge running obliquely across the basis; posteriorly this segment is rounded into a lobe. The posterior lamella has already been mentioned.

The hosts and localities are as follows: Sucker (*Catostomus* sp.), Montpelier, Vt.; *Ictalurus punctatus*, grunt, Cumberland Falls, Ky.;

Micropterus salmoides, *Iotibius cyprinella*, *I. bulbatus*, Fairport, Iowa; *Dorosoma cepedianum*, *Promoxis annularis*, *Roccus chrysops*, yellow perch (*Perca flavescens*), Little Star Lake, Wis.; *Catostomus commersonii*, Shenandoah River, Strasburg, Va.; *Ameiurus nebulosus* in Lake Erie; and on catfish in Lake Dallas, Tex.

The remains of specimens of *biramosus* in the U. S. National Museum are identical in every respect with *appendiculosus*.

ARGULUS LEPIDOSTEI Kellicott

FIGURE 44

Argulus lepidostei KELLICOTT, 1877, p. 214, figs. 1, 2.—WILSON, 1902, p. 712, pl. 16; 1916, p. 351, pl. 62, figs. 16-19, pls. 64, 65.—THIELE, 1904, p. 27.

Carapace elliptical, covering third appendages on female, almost to abdomen of male; abdomen ovate, broad at top on male, covering base of fourth appendages of both sexes; anal sinus deep, anal furcae over halfway from base, tips rounded. The respiratory areas extend only as far forward as the second maxillae. The smaller one is set in a notch in the upper mesial side of the larger with a second notch below it and a widened posterior portion (fig. 44, *b*).

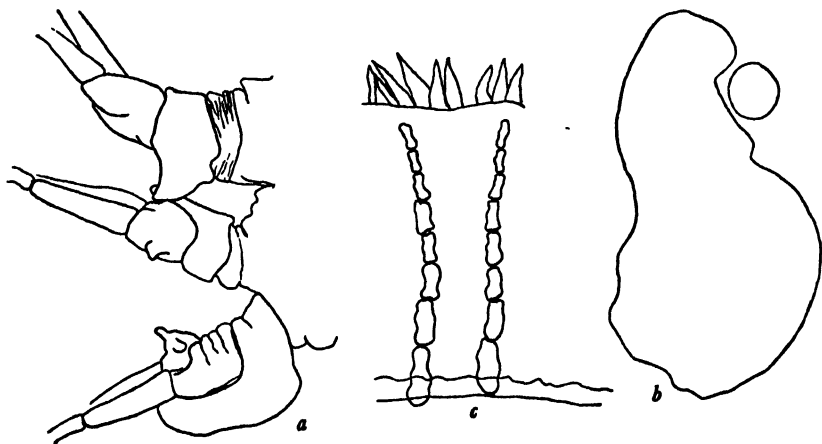


FIGURE 44.—*Argulus lepidostei*: *a*, Male accessory organs of last three legs; *b*, respiratory areas; *c*, ribs of suction cups.

First antennae with the lateral hook curved back, the anterior hook and midventral spine present, but no spine at the base. The tip of the flagellum is opposed by a slender branch. A larger spine is located at the base of the second antennae and a very large one near the midline of the body. The basal segments are not very stout. The suction cups are large and close together; rims supported by ribs made up of a series of eight or nine short rods progressively smaller

toward the edge (fig. 44, *c*). Marginal lappets long and slender. Second maxillae with a narrow basal plate, teeth standing out abruptly from it and very sharp. Two median pairs of spines very sharp, proximal tooth on plate more widely separated than other two.

Swimming appendages with flagella. Prominent boot-shaped lamella on posterior surface of fourth appendage of female, tactile papillae prominent and long. Male second appendages with a very broad thin lamella on ventral posterior edge of coxa extending considerably back over the next appendage with a lateral prolongation of distal edge. Third appendages with a long somewhat triangular flap on the anterior surface extending from the distal end of the coxa over the basis to the base of the exopod. The basis is rounded posteriorly where the socket is located; there is a slight protuberance on the ventral side of this segment. The fourth appendage has a boot-shaped lamella of considerable size without a heel. The peg is located on the distal edge of the basis near the origin of the exopod and is pear-shaped, with a broad base and a narrow short projection laterally (fig. 44, *a*). Around the base obliquely across the segment is a chitinous ridge armed with short spines. The male opening is indicated by a stout cylindrical papilla at the end of the thorax between the appendages.

Females have been reported up to 11 mm. and males to 8 mm. Found on *Cylindrosteus platostomus* and *Lepisosteus osseus* at Defiance, Ohio; Fairport, Iowa; New York Aquarium (probably from Southern States); Buffalo, N. Y.; Kingston (State not indicated by Thiele); and Put-in-Bay, Ohio. Specimens were collected at Reelfoot Lake by Dr. C. L. Baker from the short-nose gar (*Lepisosteus* sp.). Dr. Bangham collected them in Florida on the spotted gar (*Lepisosteus* sp.) at Naples and in the Everglades Canal at Woodmere and Englewood.

ARGULUS NOBILIS Thiele

FIGURE 45

Argulus nobilis THIELE, 1904, p. 28, figs. 64-76.

Argulus ingens WILSON, 1912b, p. 233, pl. 30, pl. 31, fig. 7.

Argulus nobilis var. *ingens* WILSON, 1924, p. 2.

Carapace elliptical; cephalic area prominent in male, not so prominent in female; sinus extending to the middle of carapace or beyond; alae reaching to the edge of the abdomen. Abdomen heart-shaped in female, with anterolateral projections in male; anal sinus extending almost to middle of abdomen in male, reaching middle in female; tips of abdomen pointed, sides of sinus flaring; anal furcae one-third

to one-half distance to the base of sinus. Respiratory area as in figure 45, *a*.

First antennae with anterior hook and a ventral spine, none at base; flagellum with biramous tip, one branch secondarily branched; second antennae with spine at base; third spine near midline.

Suction cups with 12 to 14 segments in ribs supporting the rim (fig. 45, *b*). Second maxillae stout, rounded papilla on posterior ventral surface of third joint opposing claws of terminal joint on male; basal plate with three sharp teeth, papilla small and round, armed with long setae; two pairs of postmaxillary spines sharp.

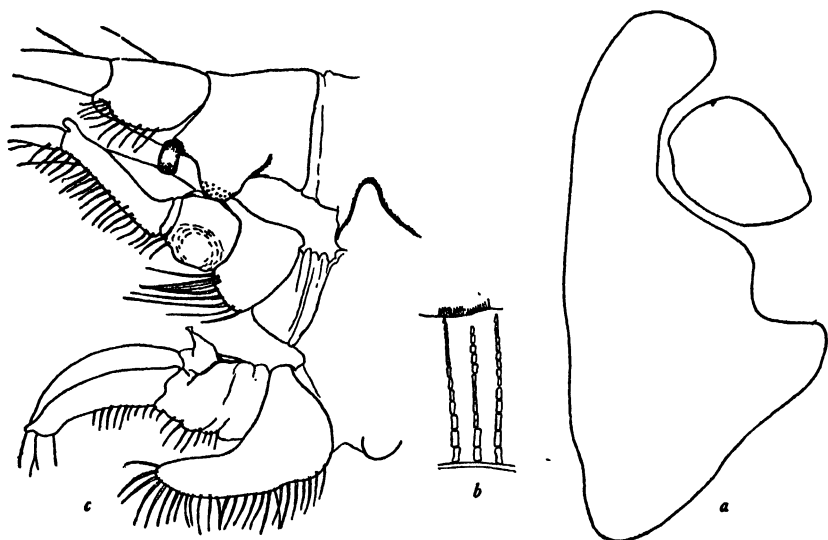


FIGURE 45.—*Argulus nobilis*: *a*, Respiratory areas; *b*, ribs of suction cups; *c*, accessory organs of last three legs of male.

First two pairs of swimming legs with flagella; anterior distal end of proximal segment of endopod with a fingerlike projection; boot-shaped lamella on posterior coxa of fourth legs of female, lamella merely prolonged laterally on the male. Male first appendage with posterior lamella on coxa and a row of setae along posterior ventral edge; second appendage with usual bilobed lamella on coxa but distal end with perpendicular papilla, proximal part of lamella saddle-shaped from a lateral view (fig. 45, *c*); coxa of third has a long fingerlike flap extending from the anterior distal edge of the segment over the basis to the expod; posteriorly the coxa is fringed with long setae. The socket is indicated by a rounded pocket on the posterior margin of the basis; the endopod is bent posteriorly at its origin and bowed anteriorly toward the joint. The fourth appendage has a lamella bearing setae on the posterior edge of the coxa, which is prolonged

laterally almost to the base of the endopod. The basis has a slight posterior rounded prominence with a few setae. The peg is set firmly on the anterior distal edge of the basis near the base of the exopod. It has the usual chitinous ridge running obliquely across the segment around its base; two rounded papillae indicate the opening of the ejaculatory duct at the end of the thorax. On the thorax of the male between the second and third swimming appendages is a pair of triangular flaplike structures, with the points of the flap directed anteriorly on each side of the body near the base of the appendage.

Length of female up to 25 mm., males about 16 mm. The hosts are the alligator gar (*Atractosteus tristoechus*), from Louisiana, Texas, and Mississippi, and the long-nosed gar (*Lepisosteus osseus*), from Ocean Pond, Lake City, Fla.

ARGULUS BICOLOR Bere

FIGURE 46

Argulus bicolor BERE, 1936, p. 580, pl. 2, figs. 17-23.

Carapace longer than wide, rounding forward into lateral sinuses, cephalic area projecting forward prominently, posterior sinus broad; alae reaching fourth swimming appendages of female, extending onto abdomen in male; last thoracic segment broad, attached to abdomen by a slender neck; anterior respiratory area small, slightly oblong, posterior one about the same width, three times as long and slightly curved (fig. 46, *a*). Abdomen about one-third covered by carapace in male, anal sinus nearly half its length, papillae inconspicuous; anal sinus of female more than half the length of abdomen.

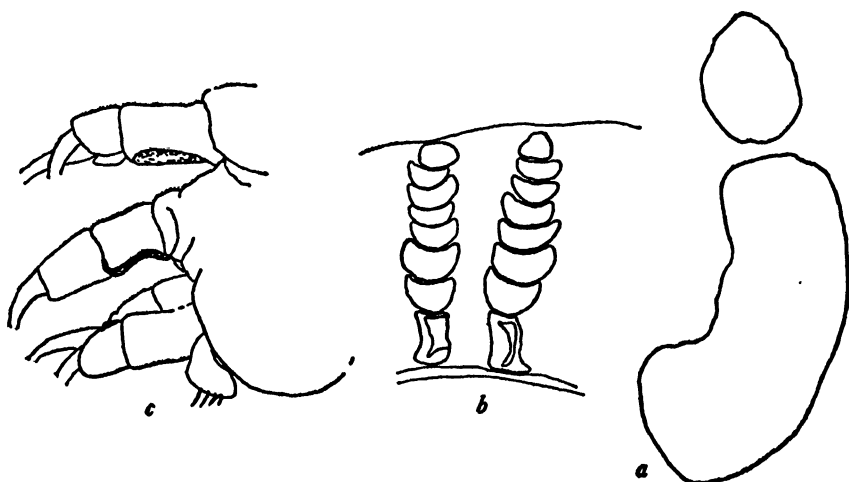


FIGURE 46.—*Argulus bicolor*: *a*, Respiratory areas; *b*, ribs of suction cups; *c*, male accessory organs of last three legs.

Antennae somewhat compressed with a prominent anterior hook, lateral hook curved back on itself; spine at base of first antennae larger than those at base of second antennae and on ventral surface of lateral hook, postantennal spines still larger, all three very broad; second antennae long. Suction cups occupying almost full width of carapace; ribs composed of 6 to 10 imbricate plates and an elongate basal segment (fig. 46, *b*). Second maxillae with two mesial spines of basal plate fairly sharp and short, lateral one broader with the spinous pad extending onto it. Postmaxillary spines very prominent.

Swimming appendages short, without flagella, very broad dorso-ventrally; first, second, and third progressively longer, fourth short and stout, unmodified except broad coxa on male; female with bilobed natatory lobe on coxa; precoxa not apparent except natatory lobes, which are prominent and extend posteriorly in the male.

Slight concavity on coxa of second swimming appendages with minute spines around the edge. The socket is a large rounded concavity on the coxa of the third appendages that fits over a swollen anterior surface of the coxa on the fourth leg rather than being a true peg. The precoxa is indicated by a somewhat triangular swimming lobe closely attached behind the abdomen (fig. 46, *c*).

Taken on the needlefish (*Strongylura notata*) and sand bream (*Archosargus unimaculatus*) in Lemon Bay, on the Gulf coast of Florida.

ARGULUS FUSCUS Bere

FIGURE 47

Argulus fuscus BERE, 1936, p. 578, pl. 1, figs. 2-10.

Carapace elongate, lateral sinuses shallow, cephalic area well marked; carapace reaching onto abdomen; posterior sinus about one-fourth its length, very narrow. Anterior respiratory area oblong, posterior one considerably wider and flaring to double the width of the anterior portion about halfway back (fig. 47, *a*). In the male the abdomen is about one-third the total length, somewhat rectangular in shape, sinus shallow, sides flaring, anal furcae basal, testes very long, reaching sinus; abdomen oblong in female, with sinus reaching over half its length.

Antennae with a prominent anterior hook, tip of lateral hook curved back on itself, flagellum of first and second antennae extending beyond lateral hook, which is short. Ventral spine prominent, basal spines of first and second antennae much smaller than post-antennal spines. Suction cups with ribs composed of 6 or 7 imbricate plates and a rectangular segment (fig. 47, *b*) in male and 12 to 14 in female, with the basal segment almost square. Second maxillae

with two mesial spines of basal plate narrow and blunt, distal one broad; postmaxillary spines long.

Swimming appendages about the same length, quite stout in male, elongate in female; without flagella. Two anterior appendages of male unmodified. Third one with a rounded knob on the dorsal anterior side of the coxa, basis elongate with the socket extending

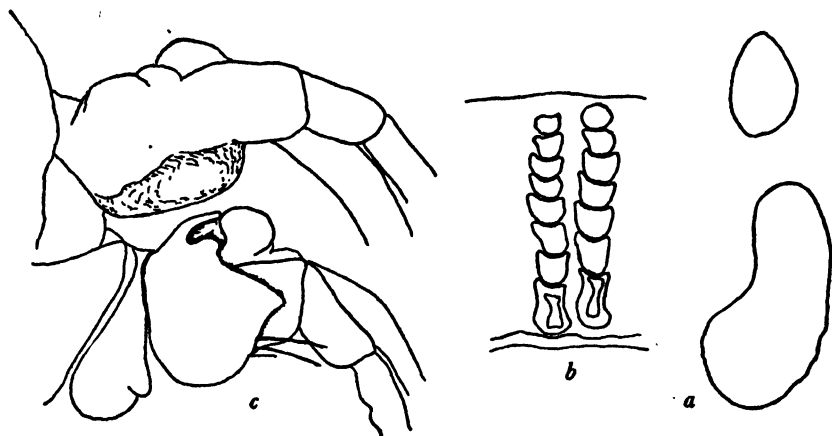


FIGURE 47.—*Argulus fuscus*: a, Respiratory areas; b, ribs of suction cups; c, male accessory organs of last two legs.

along the full length of the posterior edge, which is drawn out into a ventral flap. Fourth appendages of male very short and broad dorsoventrally. Peg a large knob on the anterior surface of the coxa; basis stout and horny, with a ridge forming a cup around the peg. Precoxa a triangular-shaped segment with base of triangle directed posteriorly and slightly lobed to form a natatory lobe (fig. 47, c); in female modified into a boot-shaped natatory lobe posteriorly.

Taken on hogfish (*Orthopristis chrysopterus*) and silver perch (*Bairdiella chrysura*) in Lemon Bay, Gulf coast of Florida.

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THE ICHNEUMON-FLIES OF THE SUBFAMILY NEORHACODINAE, WITH DESCRIPTIONS OF A NEW GENUS AND THREE NEW SPECIES

By R. A. CUSHMAN

THE three species of Neorhacodinae described herein bring the Nearctic and Neotropical regions into the known distribution of this anomalous subfamily of Ichneumonidae, add a new genus, and increase to four the number of known species.

Subfamily Neorhacodinae

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Under the name *Rhacodes* the typical genus was originally described by Ruschka from a specimen reared as a parasite of the wasp *Spilomena troglodytes* Lind. Ruschka placed the genus in the Braconidae and erected for it the new subfamily Rhacodinae.

Hedicke, finding *Rhacodes* Ruschka preoccupied by the crustacean genus *Rhacodes* Koch, renamed it *Neorhacodes* and changed the subfamily name to Neorhacodinae.

Roman, tracing the missing wing veins by reflected light, concluded the genus to be ichneumonid and placed it in the Pimplinae.

Handlirsch (1925 and 1933) elevated the subfamily to family rank and for unexplained reasons dropped it between the Aphidiidae and Stephanidae.

Fahringer (1925) followed Handlirsch in treating the group as a family but later (1933) reduced it to subfamily rank in the Braconidae, where he related it to the Helconinae and Microgasterinae. His reason for so doing appears to have been convenience, which he permitted to outweigh the natural relationship pointed out by Roman.

Waterston also recognized *Neorhacodes* as ichneumonid and, while agreeing that Roman might be correct in placing it in the Pimplinae, suggested possible relationship to the Tryphoninae.

Bischoff, also recognizing it as an ichneumonid, agreed with Roman that it should stand close to the Pimplinae but did not place it definitely in that subfamily.

Schmiedeknecht, using the original name *Rhacodes*, placed the genus at the end of the Microgasterinae without including it in his key to the genera of that subfamily.

Roman, Bischoff, and Waterston are obviously correct in placing this curious genus in the Ichneumonidae rather than in the Braconidae. As shown by the figures published by Roman and Waterston the positions of all the typical veins of the ichneumonid wings can be seen by reflected light, except the intercubiti, which are eliminated by the confluence of radius and cubitus. One detail of the venation that both Roman and Waterston figured, but which neither mentioned, is the presence of the intercubitella instead of basella. This is an ichneumonid character.

In my opinion both Roman and Waterston were correct, if *Glypta* is allowed to stand in the Pimplini and the Mesoleptini are to be considered as tryphonine, for *Neorhacodes* belongs to the great complex of internally parasitic ichneumonids, characterized by the dorsally notched ovipositor (fig. 48) and including such apparently divergent groups as the Lissonotini and most of the Ophioninae and Mesoleptini. Despite their divergence I believe these three groups are more closely related to one another than are the Lissonotini to the rest of the Ichneumoninae or the Mesoleptini to the Tryphonini. Within this complex *Neorhacodes* most closely resembles the Lissonotini, but the anomalous venation, the 13-jointed antennae, and the unusual host relation justify recognition of the group in at least the tribal rank. For the present I prefer to retain the subfamily status.

KEY TO THE SPECIES OF NEORHACODINAE

1. Tergites 1-3 with distinct transverse furrows----- 2
Tergites 1-3 without transverse furrows (Brazil).
Romaniella exsulcatus, new genus and species
2. Antenna subclavate, penultimate joint as thick as long; ovipositor barely extending beyond apex of abdomen, sheath hardly as long as first tergite (Arizona)----- *Neorhacodes brevicauda*, new species
- Antenna filiform, penultimate joint distinctly longer than thick; ovipositor strongly exerted, sheath half or more as long as abdomen----- 3
3. Sheath of ovipositor half as long as abdomen (Europe).
Neorhacodes enslini (Ruschka)
Sheath three-fourths as long as abdomen (Colorado).
Neorhacodes longicauda, new species

Genus NEORHACODES Hedicke

- Rhacodes* RUSCHKA, Archiv für Naturg., vol. 88, Abt. A, Heft 5, p. 138, fig. 8, (June) 1922.—SCHMIEDEKNECHT, Die Hymenopteren Nord- und Mitteleuropas, p. 359, fig. 61, 1930. (Preoccupied by *Rhacodes* Koch, 1856.)
- Neorhacodes* HEDICKE, Deutsche Ent. Zeitschr., p. 427, 1922.—HANDLIRSCH, Handbuch der Entomologie, vol. 3, p. 742, 1925.—FAHRINGER, Opuscula braconologica, vol. 1 (Lief. 1), p. 16, 1925.—HANDLIRSCH, Handbuch der Zoologie, vol. 4, Insecta 2, p. 962, fig. 1057, 1933.—FAHRINGER, Opuscula braconologica, vol. 4 (Lief. 1-3), p. 3, 1935.
- Neorhacodes* (Ruschka) ROMAN, Ent. Tidskr., vol. 44, Heft 3-4, p. 170, fig. 1, 1923.

Abdomen longitudinally striate or striato-shagreened, tergites 1-3 with deep transverse furrows, first tergite without longitudinal furrows apically; differing in these respects from the new genus *Romaniella*.

NEORHACODES ENSLINI (Ruschka)

- Rhacodes enslini* RUSCHKA, Archiv für Naturg., vol. 88, Abt. A, Heft 5, p. 138, fig. 8, 1922.—SCHMIEDEKNECHT, Die Hymenopteren Nord- und Mitteleuropas, p. 359, fig. 61, 1930.
- Neorhacodes enslini* (Ruschka) HEDICKE, Deutsche Ent. Zeitschr., p. 427, 1922.—ROMAN, Ent. Tidskr., vol. 44, Heft 3-4, p. 170, fig. 1, 1923.—HANDLIRSCH, Handbuch der Entomologie, vol. 3, p. 742, 1925.—WATERSTON, Entomologist, vol. 62, p. 97, fig. 1, 1929.—HANDLIRSCH, Handbuch der Zoologie, vol. 4, Insecta 2, p. 962, fig. 1057, 1933.—FAHRINGER, Opuscula braconologica, vol. 4 (Lief. 1-3), p. 3, 1935.

During his visit to Washington in 1928 Waterston showed me the specimen on which his note was based. At that time I had no other specimen of the genus to compare with it for specific differences. The original and only description of *enslini* fits the new species described below as *longicauda* very closely except in the shorter ovipositor, the basally smoother third and fourth tergites, and the basally pale flagellum and paler legs.

All (3) of the specimens of *enslini* that have been recorded were associated with the minute wasp *Spilomena troglodytes* Lind.

NEORHACODES LONGICAUDA, new species

Female.—Length 2.5 mm.

Head broader than thorax, shagreened; temples convexly receding; frons evenly convex, scrobes weakly impressed; eyes shorter than width of face, parallel within; face medially elevated and more shining; clypeus as long as face, shining, with a fringe of setae, each seta set in a deep puncture; malar space as long as basal width of mandible; antenna filiform, all flagellar joints longer than thick.

Thorax shagreened; pronotum in scrobe and mesopleuron above middle polished, the latter with a longitudinal elevation at about the middle; propodeum with median and lateral carinae strong, but apical carina weak.

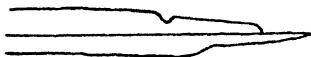


FIGURE 48.—Tip of ovipositor of *Neorhacodes longicauda*, new species.

Abdomen striato-shagreened, extreme apices of tergites 1–4 and entire fifth tergite polished; first tergite more strongly striate, transverse groove obsolete medially; tergite 4 with a shallow but distinct transverse groove, and tergite 5 with a faint trace of a groove; ovipositor sheath about three-fourths as long as abdomen.

Black; antenna dark brown, with pedicel paler; legs piceous, front and middle tibiae and tarsi (except apical joints) stramineous, hind tibia and tarsus fuscous; wings hyaline, venation dark stramineous, stigma largely fuscous, paler at base and apex, radix stramineous.

Type locality.—Four-mile Hill, 8 miles south of Steamboat Springs, Colo.

Type.—U. S. N. M. No. 53545.

One specimen from the C. F. Baker collection (No. 2030) captured by Charles Liebeck.

NEORHACODES BREVICAUDA, new species

Female.—Length 2 mm.

Differs from *longicauda* as follows: Eyes slightly convergent below, malar space much shorter than basal width of mandible; antenna slightly subclavate, penultimate joint as thick as long; apical carina of propodeum strong; abdomen more coarsely striate, tergites 4 and 5 without traces of transverse furrows; ovipositor hardly extending beyond apex of abdomen, sheath hardly as long as first tergite.

Color as in *longicauda*.

Male.—Except in slightly smaller size, differs hardly at all from female.

Type locality.—Littlefield, Ariz.

Type.—U.S.N.M. No. 53546.

One female (type) and one of unknown sex (apex of abdomen gone) collected on *Covillea tridentata* Vail, April 15, 1932, at the type locality; and one male (allotype) from the C. F. Baker collection (No. 2064) taken at Tucson, Ariz., May 20, 1896, by R. E. Kinze.

ROMANIELLA, new genus

Differs from *Neorhacodes* Hedicke only in its entire lack of transverse furrows on the abdomen, in having the abdomen uniformly shagreened and mat without any longitudinal striation, and by the presence on each side of the first tergite of a narrow longitudinal groove extending forward from the posterior margin.

Genotype.—*Romaniella cœsulcatus*, new species.

I take pleasure in dedicating this interesting genus to Dr. A. Roman, of the Stockholm Museum, in appreciation of his many courtesies and of his discriminating studies on the Ichneumonidae.

ROMANIELLA EXSULCATUS, new species

Female.—Length 2 mm.

Head broader than thorax, finely shagreened and mat; temples convex, receding; frons weakly convex; eyes slightly shorter than width of face, parallel; face medially polished and slightly elevated; clypeus polished, longer than face, apex with a fringe of setae, the setiferous punctures inconspicuous; malar space hardly as long as basal width of mandible; antenna weakly subclavate, penultimate joint as thick as long.

Thorax mat, shagreened, mesopleuron posteriorly and metapleuron more shining; notaulices faintly impressed; longitudinal and apical carinae of propodeum moderately strong.

Abdomen uniformly shagreened, more coarsely so than thorax, only narrow apices of tergites 1-4 and the whole of 5 polished; ovipositor sheath nearly two-thirds as long as abdomen.

Black; antenna stramineous at base, becoming gradually darker to brown at apex; legs stramineous, coxae and hind femur piceous, hind tibia apically and apical tarsal joints fuscous; wings hyaline, venation and radix stramineous, stigma piceous with base and apex pale.

Type locality.—Campinas, São Paulo, Brazil.

Type.—U.S.N.M. No. 53547.

One female reared from an old cotton boll, September 25, 1932, by H. F. G. Sauer.



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NOTES ON THE BIRDS OF KENTUCKY

By ALEXANDER WETMORE

As a third project in the program to obtain specimens of birds and mammals for the United States National Museum from the eastern part of our country, the Museum carried on field work in 1938 in the State of Kentucky. W. M. Perrygo, of the Museum staff, continued in charge of the field party. During the spring he was assisted by James Cole and in the fall by Herbert G. Deignan, of the division of birds, and by Gregor Rohwer. The party left Washington on April 15 and remained in the field until July 15. In the fall, work began on September 15 and ended on November 15.

In the following account I have presented the results of a study of the birds obtained, with records of all specimens taken. Also I have included reference to a few other specimens from Kentucky in the U. S. National Museum. Most of these were taken by Charles Wickliffe Beckham near Bardstown, Nelson County, and came many years ago as a gift from the collector. For a long time these skins constituted the only material from Kentucky in the collection. While Beckham published his observations¹ it is pertinent to check the identification of these specimens so far as they are available according to modern understanding of the species covered. There are also a few skins prepared by Edgar Alexander Mearns at Lexington (in November and December 1898) and casual specimens from other sources.

¹ A list of the birds of Bardstown, Nelson Co., Kentucky. *Journ. Cincinnati Soc. Nat. Hist.*, vol. 4, July 1883, pp. 136-147.

List of the birds of Nelson County. *Kentucky Geol. Surv.* (Issued Sept. 1885, according to an entry made on the cover of the copy in the division of birds, U. S. National Museum), pp. 1-58.

The data from this material are made available here for those who may be working on a list of the birds of the State or who are interested in the general distribution and occurrence of birds in this area. I have made no search of literature for other records, as assembly of that information is properly the field of others. In some cases I have included notes made by our field representatives where specimens were not taken.

With previous material from West Virginia and Tennessee available identification of the Kentucky collection has offered no particular difficulties. The State is one of large extent, so that in some cases there has been representation of both eastern and western forms of the same species. Some southern races come in along the southern border, particularly in the southwestern counties, but in the main Kentucky is north of the area of intergradation of most species having both northern and southern forms. Much work remains to be done on the distribution of birds everywhere through the State, but it is hoped that the account herewith will prove useful to those engaged in such investigations.

The work was made possible through permits issued by Major James Brown, director, Division of Game and Fish, of the Department of Conservation of Kentucky. We are under much obligation to Major Brown for his cooperation and to the enforcement officers under his direction who were universally helpful. The Department of Highways of Kentucky cooperated in issuing a set of official State license plates for the truck used for travel, required because of the length of stay of the party.

The expenses of the party in the field were carried by the income of the W. L. Abbott Fund of the Smithsonian Institution.

Throughout the entire period of work our men received the most courteous treatment, particularly in the privilege that was given them of entering private lands in order to make the necessary collections. We are deeply indebted for this friendly assistance without which the work would not have been possible.

The itinerary for the work was arranged so as to visit the eastern and western areas in both spring and fall, in order to get as representative a collection as one season's work would permit. The field party had available a small closed truck, which allowed them to cover a much wider area than would otherwise have been possible.

Field investigations began April 19, 1938, at Brandenburg in Meade County, with the weather cool but clear. This region covered the level bottomlands near the Ohio River and the rolling hills of the uplands where there were woods of cedar and oak. Through special permission investigations were made in an extensive tract of land under development for a national park at Rock Haven, where there was much of inter-

est. On May 4 the party moved to Union County with a base at Henderson, to remain until May 19. Collections were made principally near Waverly in low country where there were cypress swamps and ponds, and in the vicinity of Uniontown near the Ohio River. Some material was taken in the open fields about Corydon.

On May 20 Perrygo moved to Hickman in the extreme southwestern corner of the State, remaining until June 1. In this region arms of Reelfoot Lake extend across the State line from Tennessee. The work centered mainly in the swamps of this section and in the adjacent higher ground around the edges of the many cottonfields. By wading some distance it was possible to reach an island in the northern arms of the lake. The cypress growth was especially fine. On June 1 the men examined the small neck of land belonging to Fulton County that lies in a bend of the Mississippi River below New Madrid, Mo., where it is cut off from the rest of the State by a southward extension of Missouri. On June 2 work was moved to Monticello, where until June 18 Perrygo covered Wayne County, collecting near Monticello, Coopersville, and Rockybranch, with one trip into McCreary County in the vicinity of Stearns. There were woods of pine and oak here that extended over rolling ridges and higher knobs, with other types of woodland in the creek bottoms.

Near Cumberland a base was established in an abandoned C. C. C. camp on June 20, and from here collections were made on Black Mountain, which rises to 4,150 feet and is the highest mountain in the State. Most of the work was done between 3,800 and 4,100 feet. There were no spruce or balsam trees on this mountain, and typical Canadian Zone conditions were lacking. Rain and cold storms came regularly and interfered with studies to some extent. Some specimens were obtained also on the long ridge of Pine Mountain southeast of Whitesburg.

On July 2 the party removed to Belfry, a mining town, and located at a tourist camp, remaining until July 10. From this point Perrygo crossed into West Virginia to obtain a few additional specimens wanted, under a permit issued for the purpose by the Conservation Commission of West Virginia through H. W. Shawhan. In the meanwhile Cole remained in the Kentucky area.

On leaving here the men made camp near Fullerton beside an Indian mound on the bank of the Ohio River and remained until July 14. Weather continued stormy at intervals with heavy hail, and on the day before they left a strong wind blew over their tents. From this point the party returned to Washington for the summer.

For the fall season Perrygo had as assistants Herbert G. Deignan, of the division of birds, and Gregor Rohwer, employed specially for this work. On September 16 this party located in Middlesboro to work principally on Log Mountain, which lies 7 miles west. Here the writer

joined them from September 23 to 25, the rest remaining until September 29. The American Association Coal Co. gave permission for work on its lands here. Log Mountain is covered with deciduous forest and is rather dry, but good collections both of birds and mammals were made between 2,000 and 2,900 feet elevation. Some specimens were taken in the lowlands southeast of Middlesboro.

On October 1 the party was established south of the town of Berea and continued investigations here in Rockcastle and Madison Counties, near Mount Vernon, Berea, and Richmond, until October 7. A considerable part of this area is poorly drained so that there are many wet meadows, making conditions for small birds excellent. From October 7 to 9 the men were located at Morehead, Rowan County, where they had the cooperation of Prof. Wilfred A. Welter, of State Teachers College, in selecting desirable areas for work. From here they continued to the Ohio River below Covington to record the fall migration, collecting until October 15 near Ghent and English in Carroll County, near Burlington and Florence in Boone County, near Warsaw in Gallatin County, and near Bedford in Trimble County. The bottomlands along the Ohio and the bluffs and rolling hills inland gave a diversified terrain in which were many birds.

On October 16 they removed to Madisonville, where special attention was given to cypress swamps and the adjacent areas in Hopkins, McLean, and Muhlenberg Counties. Collections were made near Sacramento, South Carrollton, and Madisonville, the region proving an excellent one. On October 28 a new base was selected at Cadiz for work in the narrow tract of land between the Tennessee and Cumberland Rivers in Trigg County, and at points farther to the east. Birds were obtained mainly at Canton, with a few specimens from Golden Pond, Cadiz, Princeton, and Cerulean.

On November 6 Perrygo located at Brownsville for the final work of the season in the cedar-covered hills, oak woods, and farmlands of the region near Mammoth Cave. From here collections were made at Roundhill and Fairview, but most of the material was obtained near Brownsville. The studies for the season ended on November 14.

Family ARDEIDAE

ARDEA HERODIAS WARDI Ridgway: Ward's Heron .

Two adult females taken on an arm of Reelfoot Lake $4\frac{1}{2}$ miles southwest of Hickman on May 24 and 26 are of this race. Their measurements might fit either the northern or southern form of great blue heron, being within the maximum range of the former and the minimum of the latter, but the color of the neck and of the back is distinctly pale, which places them with the southern bird. Measure-

ments of the two are as follows: Wing 465, 473; tail 165, 176; culmen from base 142.3, 144.9; tarsus 169, 185 mm.

The presence of this race in southwestern Kentucky need occasion no surprise since Ward's heron is already known as the breeding bird of Reelfoot Lake in Tennessee.² It is probable that Ward's heron is confined in Kentucky to this general region and that the birds recorded by Perrygo near Uniontown along the Ohio River on May 10 and 13, and near Waverly on May 9, were the typical great blue heron (*Ardea herodias herodias*). This, however, is supposition, as no specimens were obtained.

CASMERODIUS ALBUS EGRETTA (Gmelin): American Egret

Two beautiful birds in full plumage, male and female, were taken at an arm of Reelfoot Lake $4\frac{1}{2}$ miles southwest of Hickman, May 23.

BUTORIDES VIRESCENS VIRESCENS (Linnaeus): Eastern Green Heron

The first one seen was found near Brandenburg on April 28. At Uniontown one was taken near the Ohio River on May 13, and at Waverly another was secured on May 16. One was shot near Rockybranch, Wayne County, June 8, and another was seen near Stearns, McCreary County, June 16. In fall one was recorded near the Ohio west of Burlington on October 10.

BOTAURUS LENTIGINOSUS (Montagu): American Bittern

A male was taken near the Ohio River 6 miles west of Burlington on October 10.

Family CATHARTIDAE

CATHARTES AURA SEPTENTRIONALIS Wied: Eastern Turkey Vulture

This widely distributed bird was observed at many localities. One specimen was taken, a male, 4 miles southwest of Warsaw on October 12. A flock was seen on this occasion. The wing in this bird measures only 521 mm., but the outer primaries seem to have been molted recently and are probably not quite grown, so that the measurement would have been increased somewhat. The tail is 245 mm.

CORAGYPS ATRATUS (Meyer): Black Vulture

Records for this southern species are as follows: Hickman, May 31 (specimen); Cerulean Springs, Trigg County, November 5; Roundhill, Butler County, November 7 and 12; Brandenburg, April 22; and Warsaw, October 12. None were observed in the more eastern sections of the State. The bird taken, a female, has a wing measurement of 412 mm.

² Ganler, A. F., Tennessee Avifauna No. 2, Feb. 1933, p. 12.

Family ACCIPITRIDAE

ACCIPITER STRIATUS VELOX (Wilson): Sharp-shinned Hawk

Two immature birds were taken near Canton, November 1, and 11 miles south of Brownsville, November 11. One was seen on Shady Spur, 7 miles west of Middlesboro, on September 17.

BUTEO JAMAICENSIS BOREALIS (Gmelin): Eastern Red-tailed Hawk

During the breeding season one of these hawks was seen on June 10 near Monticello, and others at about 4,000 feet elevation on Black Mountain, 4 miles southeast of Lynch, June 25 and 30. On Log Mountain, 7 miles west of Middlesboro, one or two were seen on nearly every visit between September 19 and 26. An adult and an immature bird were taken here. The only other one recorded was seen near Canton, Trigg County, on November 1.

BUTEO LINEATUS LINEATUS (Gmelin): Northern Red-shouldered Hawk

Records for this hawk are as follows: Hickman, May 21 and 28; Canton, November 1; Cerulean Springs, November 5; Madisonville, October 22; Sacramento, October 17; Uniontown, May 10, 13, and 17; Waverly, May 12; Belfry, Pike County, July 5.

Two males and one female, taken near the northern extremity of Reelfoot Lake, $4\frac{1}{2}$ miles southwest of Hickman, in dark color are typical of the northern race. They measure as follows: Males, wing 308, 309, tail 191, 205, culmen from cere 21.5, 22.5, tarsus 80.5, 85.6 mm.; female, wing 342, tail 204, culmen from cere 23.1, tarsus 88.7 mm. A young male not quite grown was taken from the nest at this point on May 28. Near Uniontown a female was shot on May 13 that is in the streaked plumage of the immature stage, considerably worn.

CIRCUS CYANEUS HUDSONIUS (Linnaeus): Marsh Hawk

Single birds were seen at Roundhill on November 9 and near Richmond on October 4.

PANDION HALIAETUS CAROLINENSIS: Osprey

One was seen at Rock Haven, Meade County, April 25.

Family FALCONIDAE

FALCO PEREGRINUS ANATUM Bonaparte: Duck Hawk

One was seen 4 miles east of Monticello, June 14.

FALCO COLUMBARIUS COLUMBARIUS Linnaeus: Eastern Pigeon Hawk

One was seen on September 22 by H. G. Deignan near the fire tower on the summit of Log Mountain west of Middlesboro.

FALCO SPARVERIUS SPARVERIUS Linnaeus: Eastern Sparrow Hawk

Found sparingly throughout the State as the following records indicate: Cerulean Springs, Trigg County, November 5; Waverly, May 9; Madisonville, October 21 and 22; South Carrollton, October 22; Brandenburg, April 23; Roundhill, November 9; Brownsville, November 12; Monticello, June 11; Mount Vernon, October 1 and 4; 4,100 feet elevation on Black Mountain, 5 miles southeast of Lynch, June 29; Fullerton, July 13. The majority of the observations were of one bird or occasionally of two in a day.

Family TETRAONIDAE

BONASA UMBELLUS TOGATA (Linnaeus): Canada Ruffed Grouse

The only one recorded during the present work was seen 5 miles west of Mount Vernon. As it was not taken its identification to subspecies is based on supposition only.

Family PERDICIDAE

COLINUS VIRGINIANUS VIRGINIANUS (Linnaeus): Eastern Bobwhite

Of two shot near Bedford, Trimble County, October 13, a male is typical of the eastern bobwhite, while a female shows a strong infusion of the characters of the so-called "Mexican" bobwhite that has been imported so abundantly in the Eastern United States. This hybrid bird is distinctly grayer above than the native stock, but at the same time it shows more brown than the introduced bird. Below, the markings are those of the eastern bobwhite.

Other quail were seen near Corydon, May 14; at Brownsville, November 8; Golden Pond, Trimble County, November 3; and Rockybranch June 13.

COLINUS VIRGINIANUS TEXANUS: Texas Bobwhite

Of this introduced bird, usually called the "Mexican quail," a typically marked adult male was shot near Burlington along the Ohio River on October 10. This specimen has the gray upper surface and the heavily barred breast characteristic of this form. Major James Brown, Director, Division of Game and Fish of the Department of Conservation, informs me that the State authorities have imported quail from Mexico for years, and also have brought brood stock from elsewhere in the United States. The present wild stock of bobwhite is therefore of mixed blood to a high degree.

Family RALLIDAE

FULICA AMERICANA AMERICANA Gmelin: American Coot

One was obtained along the Ohio River near Burlington, October 11.

Family CHARADRIIDAE

OXYECHUS VOCIFERUS VOCIFERUS (Linnaeus): Killdeer

On June 1 an adult male was collected on the bank of the Mississippi River in that small area of land cut off from Fulton County in the bend of the river directly south of New Madrid, Mo. Two others were taken at Golden Pond, November 4, and two more at South Carrollton, October 25. A number were recorded at Greenup on July 12 and 13. The species is distributed in suitable localities throughout the State.

Family SCOLOPACIDAE

PHILOHELA MINOR (Gmelin): American Woodcock

Single birds were seen near Ghent, October 14, and at Roundhill, November 7.

CAPELLA DELICATA (Ord): Wilson's Snipe

One was seen near Golden Pond on November 3.

ACTITIS MACULARIA (Linnaeus): Spotted Sandpiper

One was taken near Hickman on May 26.

TRINGA SOLITARIA SOLITARIA Wilson: Eastern Solitary Sandpiper

Near Waverly two females were taken on May 9 and another on May 16. These three are all representative of the eastern race, as indicated by small size and immaculate inner web of the outer primary. The wing measurements are 127.4, 129.7, and 130 mm.

CATOPTROPHORUS SEMIPALMATUS INORNATUS (Brewster): Western Willet

A female taken on the bank of the Ohio River 2 miles northeast of Uniontown on May 5 has the following measurements: Wing 210, tail 84, culmen from base 66.7, tarsus 68.2 mm.

Family COLUMBIDAE

ZENAIIDURA MACROURA CAROLINENSIS (Linnaeus): Eastern Mourning Dove

Specimens of the mourning dove were taken as follows: 4½ miles southwest of Hickman, May 31; Canton, October 29; Madisonville, October 20 and 21; Waverly, May 16; Rock Haven, April 25 and 26; Rockybranch, June 7; Monticello, June 15. All show the darker color of the eastern race, with no approach to the paler western bird. The species was seen in almost all localities visited, the last in fall being noted near Roundhill on November 7.

Family CUCULIDAE

COCYZUS AMERICANUS AMERICANUS (Linnaeus): Yellow-billed Cuckoo

Specimens were secured as follows: Waverly, May 17; Monticello, June 15; Middlesboro, September 17 and 25; and Morehead, October 8, this being the last one recorded for fall. Individuals were seen near Quincy on July 12 and 13.

COCYZUS ERYTHROPHthalmus (Wilson): Black-billed Cuckoo

This cuckoo was taken near Uniontown on May 10 and 3 miles east of Waverly on May 16, these being the only days on which the species was observed.

Family STRIGIDAE

OTUS ASIO ASIO (Linnaeus): Southern Screech Owl

In the three specimens from Kentucky at hand there is one female in gray phase collected near Lexington on December 5, 1898, by E. A. Mearns with the wing measuring 163 mm., and one in red phase from 4 miles southwest of Florence, shot on October 11, 1938, by Perrygo and Deignan, with the wing 158.5 mm. A red male from Fairview, November 10, measures 149 mm. These dimensions are all within the limits assigned to the southern bird, which on the basis of these skins seems to be the resident form of the State. The northern race perhaps may reach Kentucky during winter.

STRIX VARIA VARIA Barton: Northern Barred Owl

The barred owl was collected at Madisonville on October 21, South Carrollton on October 24, and near Roundhill on November 11. Another was obtained near Brandenburg on May 2, and one was recorded near Rockybranch on June 13. All the specimens show the feathering of the foot found in the northern bird.

Family CAPRIMULGIDAE

ANTROSTOMUS CAROLINENSIS (Gmelin): Chuck-will's-widow

Near Monticello, Wayne County, one was calling on June 7.

ANTROSTOMUS VOCIFERUS VOCIFERUS (Wilson): Eastern Whip-poor-will

One was seen on April 16 at Cannonsburg in Boyd County, and one was heard calling 4 miles east of Cumberland, Harlan County, on June 23.

Family MICROPODIDAE

CHAETURA PELAGICA (Linnaeus): Chimney Swift

The chimney swift was first observed in spring at Brandenburg on April 18.

Family TROCHILIDAE

ARCHILOCHUS COLUBRIS (Linnaeus): Ruby-throated Hummingbird

In the western section of the State a female was taken near Waverly on May 16 and a male $4\frac{1}{2}$ miles southwest of Hickman on May 30. On Black Mountain hummingbirds were common in June, and a female was secured on June 25. Others were observed on Log Mountain near Middlesboro from September 21 to 28.

Family ALCEDINIDAE

MEGACERYLE ALCYON ALCYON (Linnaeus): Eastern Belted Kingfisher

Observed at Brandenburg on April 23, at Uniontown on May 10, and near Middlesboro on September 19 and 23.

Family PICIDAE

COLAPTES AURATUS AURATUS (Linnaeus): Southern Flicker

The only specimen obtained of this southern race, distinguished only by smaller size, is a male taken 11 miles south of Brownsville, Edmonson County, on November 11. This bird has the following measurements: Wing 146.5, tail 98.6, culmen from base 35.5, tarsus 28.7 mm.

As *C. a. auratus* nests throughout most of western Tennessee, further collections of flickers should be made along the southern border of Kentucky during spring and summer to determine whether the southern bird may not extend a short distance into the southern counties. The specimen from Brownsville comes from an area where *luteus* may be the breeding form (though this is supposition only), in which case it would be a wanderer from farther south.

COLAPTES AURATUS LUTEUS Bangs: Northern Flicker

The northern flicker was collected as follows: $4\frac{1}{2}$ miles southwest of Hickman, May 21; South Carrollton, October 22; Roundhill, November 11; Brandenburg, April 21; Brownsville, November 10; English, Carroll County, October 12; Lexington, December 5 (taken by E. A. Mearns); Log Mountain, near Middlesboro, September 17 and 23; 3800 feet elevation on Black Mountain, near Lynch, June 23; and Fullerton, July 13. Immature birds only recently from the nest were taken as follows: Rockybranch, June 13; 3900 feet elevation on Black Mountain, near Lynch, June 24; and Fullerton, July 13. The adults are all characterized by a wing size from 151.5 to 156.7 mm.

A male from near the northern arm of Reelfoot Lake in Fulton County, southwest of Hickman, has the wing 153.5 mm., and so has the size of *luteus*, a matter of interest since birds from near Horn-

beak, Obion County, Tenn., only a short distance to the south, are *auratus*. Specimens taken on Black Mountain on June 23 and at Fullerton on July 13 have the tips of the primaries broken by wear so that they seemingly have small measurements, though in reality they are the northern bird.

One male from Middlesboro has a few red feathers in the moustachial streaks on each side of the head.

CEOPHLOEUS PILEATUS PILEATUS (Linnaeus): Southern Pileated Woodpecker

Adult specimens of this great woodpecker were obtained as follows: 4½ miles southwest of Hickman, May 21 and 26; South Carrollton, October 25; and Brownsville, November 10 and 11. These all agree in the small size that marks the southern form of this bird. In three males the wing measures 212, 225, and 227 mm., and in two females it is 220 and 224 mm. It will be noted that all come from the southern half of the State, but it seems probable that this is the race that extended formerly throughout Kentucky.

A young female nearly grown was secured near the northern arm of Reelfoot Lake southwest of Hickman, May 30, and another near Coopersville in Wayne County, June 8. Among other records of interest one was observed 4 miles southeast of Brandenburg, April 27, and several were recorded in Wayne County near Rockybranch on June 7 and 13 and 4 miles east of Monticello, on June 10. Two were observed near Mount Vernon on October 3. Pileated woodpeckers were found along the Cumberland River near Canton on October 31 to November 2 and in the same general region 5 miles northeast of Golden Pond on November 3. Two were seen near Roundhill, in Butler County, November 9.

CENTURUS CAROLINUS (Linnaeus): Red-bellied Woodpecker

This handsome woodpecker is common in the State, being represented by specimens from the following localities: Near Hickman, May 24; Canton, October 31 and November 2; South Carrollton, October 22; Uniontown, May 10; Roundhill, November 7 and 9; Rock Haven, April 26; Ghent, October 11; Rockybranch, June 14; Monticello, June 10; Mount Vernon, October 1; Lexington, November 17, 21, and 25 and December 1, 1898 (taken by E. A. Mearns); 2,800 and 2,900 feet elevation on Log Mountain, 7 miles west of Middlesboro, September 19 and 21.

Measurements of these Kentucky specimens are as follows: Males (10 specimens), wing 124.6–132.7 (128.9), tail 71.6–82.8 (76.5), culmen from base 28.3–32.5 (30.9), tarsus 22.1–23.7 (22.4) mm. Females (8 specimens), wing 121–132.6 (126.3), tail 69.3–77.3 (74.2), culmen from base 27.0–29.7 (28.2), tarsus 20.0–24.3 (21.8) mm. These dimensions agree fairly closely with those of a small series from Ten-

nessee. Two males from Hickman have a suffusion of red across the upper throat.

MELANERPES ERYTHROCEPHALUS ERYTHROCEPHALUS (Linnaeus): Eastern Red-headed Woodpecker

This woodpecker was of irregular distribution, though in places it was fairly common. In the nesting season it was recorded at Rock Haven on April 25 and 26, eight being seen on the first date mentioned. One was taken at Brandenburg, on April 30. Another was obtained at Monticello on June 11. In fall a number were found around Madisonville, October 20 and 21, and at Sacramento, October 17. Near Middlesboro three were seen at 2,900 feet elevation on Log Mountain on September 19, and an immature bird with a few red feathers appearing on the side of the head and the neck was taken.

Adult specimens secured all agree in size with the dimensions assigned to the eastern race as the following measurements show: Males (3 specimens), wing 133.5, 138.9, 141.2, tail 70.9, 74.7, 77.1, culmen from base 27.9, 29.2, 30.3, tarsus 21.2, 22.8, 22.8. Female (1 specimen), wing 134.1, tail 76.2, culmen from base 28.1, tarsus 21.4.

SPHYRAPICUS VARIUS VARIUS (Linnaeus): Yellow-bellied Sapsucker

Fall migrants were first observed near Mount Vernon on October 1, and two skins were obtained here on October 3. Other specimens came from Cerulean, November 5; Canton, November 2; South Carrollton, October 22; Roundhill, November 9; Brownsville, November 11; and Ghent, October 14. There is one skin in the collection obtained by Beckham at Wickland, Nelson County, on November 26, 1881.

DRYOBATES VILLOSUS VILLOSUS (Linnaeus): Eastern Hairy Woodpecker

Specimens of this common woodpecker were secured as follows: Golden Pond, November 3; Waverly, May 11; South Carrollton, October 22 and 25; Roundhill, November 9; Ghent, October 12, 13, and 14; Lexington, November 17, 1898 (taken by E. A. Mearns); Berea, October 6; Rockybranch, June 14; 2,800 feet on Log Mountain, 7 miles west of Middlesboro, September 23; 4,000 feet elevation on Black Mountain, near Lynch, June 23. Young birds fully grown were taken at Waverly, May 11, and Monticello, June 10.

While these are all identified as typical *villosus*, this is done with some reservation as to birds from the western part of the State, since specimens from this section in slightly smaller size show approach to the southern race *audubonii*. The region is distinctly one of intergradation between northern and southern birds, and specimens should be examined from along the Mississippi River where it seems probable that *audubonii* may occur.

In the present collection three skins from the cypress swamps near South Carrollton in Muhlenberg County are puzzling, since, while one male has the wing 117.3 mm., two females measure only 114.4 and 114.8 mm. The dimensions of the females are distinctly within the upper size range of *audubonii*. It may be noted that a downy woodpecker from this same area was also intermediate between the northern and southern forms, so that here there seems to be a restricted region that may be considered as definitely southern in its affinities entirely cut off except along its drainage to the Ohio from other influences of a southern nature. One male from Lexington also shows small size as the wing measures only 115.6 mm. Females from Golden Pond, Trigg County, measure 116.0 and 116.4 mm., and one from Waverly, Union County, has the wing 116.1 mm.

Aside from the three small birds mentioned size range in the wing in the series is as follows: Males, 116.6 (much worn) to 122.4 mm.; females 116.0 to 116.7 mm.

DRYOBATES PUBESCENS MEDIANUS (Swainson) : Northern Downy Woodpecker

An excellent series of this common bird was obtained as follows: Hickman, May 21 and 25; Canton, October 29; Madisonville, October 21; South Carrollton, October 18; Roundhill, November 7 and 9; Brownsville, November 10; Rock Haven, April 25; Ghent, October 11; Burlington, October 11; Lexington, November 17 and December 1, 1898 (collected by E. A. Mearns); Mount Vernon, October 1, 3, and 6; Monticello, June 9; Rockybranch, June 7; Stearns, June 16; 2,000 to 2,800 elevation on Log Mountain, near Middlesboro, September 20, 21, and 23; 4,000 feet elevation on Black Mountain near Lynch, June 23 and 29. In these specimens there is some gradation in size, birds from the southwestern section and from the southern counties west of the mountain area being only slightly larger in wing measurement than the southern race. These skins, regardless of sex, range from 91.1 to 92.5. Specimens from Brandenburg, Burlington, Ghent, Rock Haven, and Lexington are larger, running from 92.2 to 95.1 mm. in length of wing. In the entire series there are four skins that are slightly below the size ordinarily accepted for *medianus*. These include a female from near Hickman with a wing 90.5 mm., though another taken at the same time and place measures 91.1 mm. These two agree with others from the Reelfoot Lake area in Tennessee, and while somewhat intermediate they are considered to be the northern form. There is also a male from Rockybranch taken on June 7 that measures 89.9 mm., and one shot at 4,000 feet elevation on Black Mountain near Lynch that is only 89.0 mm., but these two have the wing abraded and worn so that the small measurement is false, being due to breakage and loss at the tips of the longer primaries. All the birds listed are identified as

medianus, which appears to be the resident breeding form throughout the State. A single male from South Carrollton taken on October 18 with the wing 90.5 mm. comes within the maximum size limit of the southern *pubescens* but is considered only as a tendency toward an intermediate condition and is therefore placed with *medianus*. A female taken at the same time has the wing 91.5 mm.

Dr. Lawrence E. Hicks³ speaks of specimens from the lowlands of eastern and southeastern Kentucky as similar to two birds taken along the Ohio River near Proctorville and South Point in extreme southern Ohio, which have been identified by Oberholser as *D. p. pubescens*, though not wholly typical. As noted above, specimens I have seen from southwestern Kentucky while intermediate seem nearer *medianus* and are so identified. The male listed from South Carrollton, Ky., comes nearest to *pubescens*, as it has a dark breast, but until further information that may cause a change in opinion is available it seems necessary to list all the Kentucky material that I have seen as *medianus*.

DRYOBATES PUBESCENS NELSONI Oberholser: Nelson's Downy Woodpecker

In the series of downy woodpeckers there is one female, taken 2 miles north of Mount Vernon, Rockcastle County, October 3, that stands out from the others in the pure white color of the under surface and so attracts immediate attention. This bird measures as follows: Wing 99.0, tail 63.2, culmen from base 17.6, and tarsus 17.3. From its large size and light color it seems without question to be a migrant of the far northern Nelson's woodpecker, being apparently the most southern point at which this form has yet been taken.

Family TYRANNIDAE

TYRANNUS TYRANNUS TYRANNUS (Linnaeus): Eastern Kingbird

Specimens were obtained as follows: Waverly, May 6 and 11; Brandenburg, April 27; near Coopersville, Wayne County, June 8.

MYIARCHUS CRINITUS BOREUS Bangs: Northern Crested Flycatcher

The crested flycatcher was common in a dense cypress swamp near the northern arm of Reelfoot Lake southwest of Hickman, where specimens were taken on May 27. Others were obtained at Waverly on May 6 and 9, while the first one of the season was secured at Brandenburg on April 30. An adult male in rather worn plumage was shot near Monticello on June 15, and at Rockybranch an adult female was taken on June 14 and a young bird just from the nest on June 15.

³ Auk, 1939, p. 84.

As in the case of birds from Tennessee, the Kentucky specimens are typical of the northern race, being marked from the southern form by smaller bill and light dorsal coloration.

SAYORNIS PHOEBE (Latham): *Eastern Phoebe*

In the nesting period the phoebe was secured at Waverly, May 17; Brandenburg, April 28; Monticello, June 10 and 11; and Belfry, Pike County, July 4. The birds were common in the fall, being secured at this season at Canton, October 31; South Carrollton, October 18 and 22; Roundhill, November 9; Burlington, October 11; Mount Vernon, October 3 and 4; and Middlesboro, September 28.

EMPIDONAX FLAVIVENTRIS (Baird and Baird): *Yellow-bellied Flycatcher*

A female was collected in a cypress swamp about 4 miles southwest of Hickman, May 20.

EMPIDONAX VIRESCENS (Vieillot): *Acadian Flycatcher*

The specimens taken include the following: Hickman, May 21, 25, 27; Uniontown, May 10; Brandenburg, April 28; Monticello, June 9, 10.

MYIOCHANES VIRENS (Linnaeus): *Eastern Wood Pewee*

This is one of the common flycatchers of the State, being taken as follows: Near Hickman, May 21, 24, 25, and 30; Uniontown, May 10 and 17; Brandenburg, May 3; Rockybranch, June 13; Coopersville, June 3; Middlesboro, September 20, 21, and 23; 4,100 feet elevation on Black Mountain, near Lynch, June 21, 22, and 23.

Family ALAUDIDAE

OTOCORIS ALPESTRIS PRATICOLA Henshaw: *Prairie Horned Lark*

In summer a horned lark was seen but not taken near Monticello, June 17. On October 27 a flock of nine was seen near South Carrollton, and a female taken is of the present race. There are also in the U. S. National Museum three males and one female, collected at Lexington November 30, 1898, by E. A. Mearns, that belong to the present form. Perrygo records 12 horned larks at Roundhill, Butler County, November 9, and 5 more at the same point on November 12, but he did not secure specimens.

Family HIRUNDINIDAE

RIPARIA RIPARIA RIPARIA (Linnaeus): *Bank Swallow*

The bank swallow was observed at Brandenburg on April 28, and one was taken at Uniontown on May 5. Others were recorded at Rockybranch, Wayne County, June 8 and 13.

STELGIDOPTERYX RUFIPENNIS SERRIPENNIS (Audubon): Rough-winged Swallow

The six specimens secured come from the following localities: Waverly, May 12; Uniontown, May 5; Cloverport, May 4; and Rockybranch, June 15. Others were seen at Monticello, June 9; Lynch, June 23; and Belfry, July 4.

PROGNE SUBIS SUBIS (Linnaeus): Purple Martin

Recorded at Rockybranch on June 8, 12, and 15.

Family CORVIDAE**CYANOCITTA CRISTATA CRISTATA (Linnaeus): Northern Blue Jay**

With regard to the blue jay the western part of Kentucky represents an area where there is approach to the southern form, most of the few breeding birds seen having the brighter blue color and more extended white on wing and tail of the northern form but ranging somewhat small for the average of that bird. Two males from near the northern arm of Reelfoot Lake measure 123.8 and 127.8 mm. in length of wing but are definitely bright blue above. This is of particular interest when it is remembered that birds from only slightly farther south in Obion County, Tenn., are nearer the southern form. A male from Waverly shot on May 11 is even deeper blue, though it measures only 122.5 mm., while another from Morganfield nearby, with the wing 132.9 mm., meets the full requirements of *cristata* in color, markings, and size. Two males from Brandenburg, measuring 127.2 and 129 mm., are a little small but otherwise typical of *cristata*. A male from 4,100 feet elevation on Black Mountain near Lynch, with the wing tip rather worn still measures 130 mm. Other breeding birds that agree with the northern type in color come from Quincy, July 11 and 13, though in these the ends of the primaries are much frayed from wear so that their actual measurements (119.6 and 128.7 mm.) are 5 to 10 mm. or so below what they would have been when the birds were in proper feather. An immature bird just from the nest was secured here.

Birds were taken in fall as follows: Madisonville, October 24 (male, wing 128 mm.); Sacramento, October 17 (males 127.4, 136.1, female 127.2); English, Carroll County, October 12 (127); Brownsville, November 10 (130.6); and Morehead, October 8 (125). On the basis of size part of these are intermediate, but in color and in amount of white they belong with *cristata*.

The intermediate character of the blue-jay population of the State is easily evident from this brief account. The interpretation presented may be subject to some modification with more material but is the best that can be given at present.

CYANOCITTA CRISTATA FLORINCOLA Coes: *Florida Blue Jay*

The only bird in the series available that seems to represent the southern form of the blue jay is an adult female taken 3 miles south of Coopersville, Wayne County, June 3. This specimen has a wing measurement of 127 mm., which is within the maximum recognized by *florincola*, though a little larger than many. In its dorsal color it agrees with skins from northern Tennessee, as it does in the reduced amount of white on the secondaries, tertiaries, and tip of the tail. It is somewhat intermediate but nearer the southern form. It is probable that the breeding bird from elsewhere along the southern border of Kentucky west of the mountain area may belong here also, although birds from Hickman belong with the northern group.

CORVUS BRACHYRHYNCHOS BRACHYRHYNCHOS Brehm: *Eastern Crow*

The breeding crows of Kentucky as represented in the available collections, while in part slightly intermediate toward the southern form, are referred in the main to the northern subspecies. Further collecting is necessary, probably in considerable amount, to determine the actual status of the nesting form along the southern border except in the west. The southern race as a breeding bird seems to come into the State along the mountains in the southeast.

Males taken near Hickman on May 21 have the wing 305 and 314 mm. and the bill 49.8 and 50.2 mm. thus resembling the longer-winged, larger-billed *brachyrhynchus*. The specimen with the apparently shorter wing of 305 mm. has the ends of the primaries considerably worn, so the true measurement in fresh plumage would have been appreciably greater. An immature male just from the nest was taken at the same time as the adults mentioned. A male from Waverly, May 5, with the wing 331 mm. and the bill 50 mm. is very large. Specimens taken near Brandenburg fit also in the category of the northern race as two males shot April 23 and May 3 have the wing 308 mm. In one the bill measures 53.3 mm. The tip of the culmen in the second is broken by shot but the bill is definitely large. A female killed May 3 with the wing considerably worn measures 289 and 47.8 mm. The April bird may have been a northern migrant, but the two taken on May 3 were nesting.

The following specimens assigned to *brachyrhynchus* were taken in fall: Princeton, November 5 (wing 311); South Carrollton, October 18 (wing 307, culmen 50.1 mm.); Brownsville, November 12 (wing 315); and Mount Vernon, October 6 (one female with wing 310 and culmen 49.3, another with wing 293 and culmen 48.4). The second female from Mount Vernon approaches *paulus*.

CORVUS BRACHYRHYNCHOS PAULUS Howell: Southern Crow

Four of the crows collected by Perrygo and his associates on the basis of smaller size are referred to the southern race. A male taken September 29 near the town of Middlesboro has the wing 289 mm. and the culmen 47.8 mm. It is presumably a bird from this general region since the date is too early for any extended migration or wandering.

The race *paulus* nests in the mountains of northeastern Tennessee and might, therefore, be expected to breed in the Middlesboro area. A male taken at Burlington on October 11 has the wing 290 mm. and the culmen 46.3 mm. A female from Brownsville shot on November 12 measures in the wing 300 mm. and in the culmen 46.1 mm. and one from Ghent 282 mm. and 46.5 mm. The smaller wing and short, slender bill place these with *paulus*. They seem to represent post-breeding wanderers.

Family PARIDAE

PENTHESTES CAROLINENSIS CAROLINENSIS (Audubon): Carolina Chickadee

Four skins taken on September 20, 23, and 26 at elevations from 2,000 to 2,800 feet on Log Mountain, between 7 and 8 miles west of Middlesboro, agree with specimens from the mountain area of eastern Tennessee in having slightly darker dorsal coloration and lighter buffy brown on the sides, differing in this from birds from central and western Kentucky. Male and female taken at 4,000 feet elevation on Black Mountain $4\frac{1}{2}$ miles southeast of Lynch show the same characters. These are referred to true *carolinensis*, agreeing with skins in similar stage of plumage from near Charleston, S. C., the type locality. The Kentucky specimens represent the most northern limit known for this race and are probably at the northern edge of its range. They show some approach in their slightly larger size to *extimus*.

PENTHESTES CAROLINENSIS EXTIMUS Todd and Sutton: Northern Carolina Chickadee

This race of the Carolina chickadee, marked by slightly paler back and brighter buffy-brown sides, together with slightly larger size, is found throughout Kentucky except in the southeast sections of the State. Specimens identified as this form were taken as follows: At the northern arm of Reelfoot Lake near Hickman, May 27 (two fully grown immature birds) and 28; Waverly, May 6; Canton, October 29; South Carrolton, October 18; Brandenburg, April 21 and 22; Brownsville, November 8; Roundhill, November 7; Burlington, October 10; Mount Vernon, October 1; Coopersville, June 6; Monticello, June 4; and Quincy, July 11.

The black-capped chickadee was not found in the mountains on the eastern border but may occur at times as a winter migrant along the Ohio River.

BAELOPHUS BICOLOR (Linnaeus): Tufted Titmouse

This familiar species, distributed throughout the State, was recorded in all the localities visited except on the higher levels of Black Mountain. Specimens were obtained as follows: Near Hickman, May 20 and 28; Canton, October 29; Waverly, May 9 and 11; Madisonville, October 21; South Carrollton, October 18; Brandenburg, April 21 and 22; Roundhill, November 9; Brownsville, November 8; Ghent, October 14; Bardstown, January 18, 1882 (taken by C. W. Beckham); Lexington, December 1, 1898 (taken by E. A. Mearns); Mount Vernon, October 3 and 6; Monticello, June 15; Coopersville, June 6; 2,000 to 2,900 feet elevation on Log Mountain, near Middlesboro, September 19, 21, and 25; and Belfry, July 6. A young bird just from the nest was secured near Hickman on May 28.

Family SITTIDAE**SITTA CAROLINENSIS CAROLINENSIS Latham: White-breasted Nuthatch**

The two races of this nuthatch found in the eastern section of North America, the larger, paler *Sitta c. carolinensis* in the north and the smaller, darker *Sitta c. atkinsi* in the south, while sufficiently distinct when specimens from the northern and southern sections of the range are compared have a broad area in which there is transition between the two and in which the nuthatch population is definitely intermediate. The State of Kentucky is included in this intermediate area, thus making the allocation of specimens difficult and in part to be accomplished only through arbitrary decision. All the skins that I have seen from Kentucky are smaller than the average typical of the northern race. Some, however, are so distinctly pale colored that it seems best to place them with true *carolinensis*.

Birds that I have identified as *carolinensis* were taken as follows: Roundhill, Butler County, November 11; Mount Vernon, Rockcastle County, October 1, 4, and 6; 2,800 and 2,900 feet elevation on Log Mountain, 7 miles west of Middlesboro, September 17, 20, and 22; and 3,800 to 4,100 feet elevation on Black Mountain, 4 miles southeast of Lynch. It will be observed that these localities are in the eastern and northern sections of the State.

SITTA CAROLINENSIS ATKINSI Scott: Florida Nuthatch

As stated above the southern race of this nuthatch is distinguished by smaller average size and darker dorsal coloration. Further, there is no gray on the crown in the female, a condition found occasionally in the northern race. Male and female taken May 27 near the northern end of Reelfoot Lake, 5 miles southwest of Hickman, agree with specimens from across the border in Tennessee and seem fairly

typical of the southern race. There are in addition a number of specimens from various localities in the western third of the State and along the southern border as far east as Wayne County that, while dark, are intermediate in color and as they carry the character of smaller size seem best placed with *atkinsi*. The females seen have the crown black. Following are specimens in this category; Golden Pond, Trigg County, November 3; Canton, November 1; Sacramento, October 17; South Carrollton, October 18 and 26; Rock Haven, Meade County, April 25; Coopersville, Wayne County, June 6; and Rockybranch, Wayne County, June 8 and 14.

The specimen from Rock Haven is the most northeastern in this group. It is a male that is distinctly dark above with a wing measurement of 84.8 mm. The birds listed from Wayne County are small and dark. It would appear that the nuthatches of the western fourth or more of the State are to be placed with the southern race, which extends to the east along the Ohio River at the northern border at least to Meade County and along the southern boundary across to Wayne County.

Family CERTHIIDAE

CERTHIA FAMILIARIS AMERICANA Bonaparte: Brown Creeper

Found in migration, the first in fall being taken on October 17 near Sacramento. One was seen near South Carrollton the day following. One was taken at Canton on October 31 and others were collected at Brownsville on November 8. There is also a specimen in the National Museum taken at Lexington, November 30, 1898, by E. A. Mearns.

Family TROGLODYTIDAE

TROGLODYTES AËDON BALDWINI Oberholser: Ohio House Wren

An adult male taken 5 miles northeast of Quincy, Lewis County, July 11, belongs to this form. Birds observed at Belfry, Pike County, July 4, may also have been of the race.

TROGLODYTES AËDON PARKMANII Audubon: Western House Wren

Near Uniontown house wrens were common, three specimens being taken on May 10, evidently breeding birds. These birds, two males and a female, are of the western race, differing from the Ohio house wren in paler, more grayish coloration, especially below, and in the lighter, brighter brown of the flanks.

NANNUS TROGLODYTES HIEMALIS (Vieillot) : Eastern Winter Wren

The winter wren was first seen in fall at 3,000 feet elevation on Log Mountain near Middlesboro on September 22, it being assumed that this was a migrant from the north. Specimens were taken at Morehead on October 8, Ghent on October 13, Madisonville on October 20, and Canton on November 1. There is a specimen in the National Museum collected at Bardstown on November 21, 1882, by C. W. Beckham.

THRYOMANES BEWICKII BEWICKII (Audubon) : Bewick's Wren

Near Brandenburg two were taken on April 22, and others were seen here on April 28 and at Rock Haven on April 26. One was secured near Mount Vernon on October 4 and one near Burlington on October 11. They were found near Monticello on June 9 and 10 and near Madisonville on October 19, and one was collected at 2,800 feet elevation on Log Mountain, near Middlesboro, on September 26.

THRYOTHORUS LUDOVICIANUS LUDOVICIANUS (Latham) : Carolina Wren

Of State-wide distribution, specimens being taken as follows: Near Hickman, May 24 and 25; Canton, October 31 and November 2; South Carrollton, October 27; Waverly, May 11; Brandenburg, April 20; Rock Haven, April 26; Roundhill, November 9; Ghent, October 13 and 14; Coopersville, June 6; Monticello, June 9 and 15; Mount Vernon, October 5; 2,600 and 2,800 feet elevation on Log Mountain, 7 miles west of Middlesboro, September 22 and 26; Belfry, Pike County, July 7. One was seen at an elevation of 4,000 feet on Black Mountain, near Lynch, on June 29.

TELMATODYTES PALUSTRIS PALUSTRIS (Wilson) : Long-billed Marsh Wren

An immature male of the eastern race of this bird was taken 6 miles south of Berea on October 5. This bird agrees in color of flanks with specimens of the same season from near Washington, D. C.

TELMATODYTES PALUSTRIS ILLACUS Ridgway : Prairie Marsh Wren

Four specimens assigned to this form were obtained, two near South Carrollton on October 24, one 6 miles west of Burlington on October 10, and one near Mount Vernon, Rockcastle County, on October 6. It will be noted that the eastern bird was taken in the same county as the one last mentioned. All specimens secured were obtained during the fall migration period, so that there is no indication available from them as to whether they breed in this area.

Todd⁴ has indicated that the proper name of the prairie marsh

⁴ Proc. Biol. Soc. Washington, 1937, pp. 23-24.

wren is *iliacus* Ridgway and not *dissæptus* of Bangs⁵ as given in the fourth edition of the A. O. U. Check-list.

CISTOTHORUS STELLARIS (Naumann): Short-billed Marsh Wren

The only ones seen were observed during the fall migration, when specimens were obtained near South Carrollton on October 18 and 24, at Canton on October 31, and 6 miles west of Burlington on October 11.

Family MIMIDAE

MIMUS POLYGLOTTOS POLYGLOTTOS (Linnaeus): Eastern Mockingbird

Three specimens of the mockingbird were obtained as follows: Canton, October 29; Madisonville, October 20; and Roundhill, November 12. The species was observed but not taken at Brandenburg, April 20 to 22; Rock Haven, April 26; Uniontown, May 10; Rockybranch, June 13; Monticello, June 15 and 16; and Middlesboro, September 23.

DUMETELLA CAROLINENSIS (Linnaeus): Catbird

The catbird was collected as follows: Uniontown, May 5; Brandenburg, April 30 and May 3; Monticello, June 10; Mount Vernon, October 6; Middlesboro, September 28; 3,800 and 3,900 feet elevation on Black Mountain, near Lynch, June 23 and 24; and Quincy, July 11. In spring the first one was seen 6 miles northwest of Brandenburg on April 21. In fall the last was recorded near Mount Vernon on October 6.

TOXOSTOMA RUFUM RUFUM (Linnaeus): Eastern Brown Thrasher

Specimens were collected as follows: Uniontown, May 10; Waverly, May 12; Brandenburg, April 29; Monticello, June 14; 2,300 feet elevation on Pine Mountain, near Whitesburg, June 29; and Quincy, July 12. These all agree in measurements with the eastern race. For discussion of the eastern and western races of this bird the reader is referred to the Proceedings of the United States National Museum, vol. 86, 1939, pp. 214 to 215.

Family TURDIDAE

TURDUS MIGRATORIUS MIGRATORIUS Linnaeus: Eastern Robin

As most of the robins secured were obtained during the period of migration the status of the breeding birds of Kentucky cannot be definitely outlined. An adult male from 4 miles west of Stearns, McCreary County, shot on June 16, is somewhat intermediate toward

⁵ *Cistothorus (Telmatochytus) palustris dissæptus* Bangs, Auk, 1902, p. 352 (Wayland, Mass.).

achrusterus, having a wing measurement of 127.4 mm. and the color of the lower surface slightly paler than typical *migratorius* (though above it is dark). Two skins in spotted juvenal plumage, fully grown, from Quincy, July 12, have the long wing of the northern race.

The following skins were taken when northern migrants may have been present: South Carrollton, October 22; Golden Pond, November 3; Canton, October 31; Brandenburg, April 29 (a pair of fully typical northern birds, possibly breeding); Brownsville, November 10; Ghent, October 14; Berea, October 6.

TURDUS MIGRATORIUS ACHRUSTERUS (Batchelder): Southern Robin

An adult female shot at 4,100 feet elevation on Black Mountain, 4 miles southeast of Lynch, June 21, has the wing 120.7 mm. and the coloration very pale, being typical of the southern form. This should be the bird that nests along the southern border of Kentucky, but this can be ascertained only by further collecting.

It may be noted that an adult male from 9 miles east of Williamson, W. Va., collected on July 8, 1938, is typical *achrusterus*.

HYLOCICHLA MUSTELINA (Gmelin): Wood Thrush

The wood thrush, distributed in summer throughout Kentucky, was obtained as follows: Uniontown, May 13; Brandenburg, April 28 and May 2; Rock Haven, April 26; Log Mountain, near Middlesboro, September 23; 4,100 feet elevation on Black Mountain near Lynch, June 21; Belfry, Pike County, July 4 and 9 (the last an immature bird not quite grown); and Quincy, July 12.

HYLOCICHLA GUTTATA FAXONI Bangs and Penard: Eastern Hermit Thrush

Specimens were taken as follows: Madisonville, October 25; Brownsville, November 8; Roundhill, November 9; Ghent, October 12 and 14; Morehead, October 8.

HYLOCICHLA USTULATA SWAINSONI (Tschudi): Eastern Olive-backed Thrush

Two were taken in fall migration at 2,800 and 2,900 feet elevation on Log Mountain, 7 miles west of Middlesboro, on September 17 and 19.

HYLOCICHLA USTULATA ALMAE Oberholser: Western Olive-backed Thrush

That this form, described originally from the Great Basin, is truly distinct has been indicated recently by van Rossem⁶ and by Oberholser⁷ on the basis of more grayish, less brownish dorsal coloration. As a migrant this bird occurs casually to the eastward, and it is of

⁶ Field Mus. Nat. Hist. Publ., Zool. Ser., vol. 23, 1938, p. 457.

⁷ Louisiana Dept. Cons. Bull. 28, 1938, p. 472.

interest to record the following specimens in the present collection: Uniontown, May 10, male and female; 6 miles northwest of Brandenburg, May 3, adult female; 2,800 feet elevation on Log Mountain, 7 miles west of Middlesboro, September 17, adult male and immature female.

HYLOCICHLA MINIMA MINIMA (Lafresnaye): Gray-checked Thrush

The four specimens obtained were collected at Mount Vernon on October 1 and 3 and on Log Mountain, near Middlesboro, on September 25 and 28. These birds, all males, are representative of the larger, northern form of this bird as indicated by their wing measurements, which are 98.5, 99.8, 102.5, and 102.9 mm.

According to recent studies by George J. Wallace^{*} the type specimen of Lafresnaye's *Turdus minimus* instead of being the smaller Bicknell's thrush as identified some years ago by Bangs and Penard (whose statement was accepted for the fourth edition of the A. O. U. Check-list) is in reality the larger, northern bird currently recognized in the check-list as *H. m. aliciae*. Lafresnaye's type, according to Wallace, has a wing measurement of 99 mm., which places it clearly with the larger bird, an opinion with which J. L. Peters (in litt.) agrees. Under these circumstances therefore the gray-checked thrush is to be known as *Hylocichla minima minima*.

HYLOCICHLA FUSCESCENS FUSCESCENS (Stephens): Veery

On Black Mountain, Harlan County, the veery is a common breeding bird at elevations ranging from 3,800 to 4,100 feet. Four specimens were secured here on June 21, 23, and 30.

HYLOCICHLA FUSCESCENS SALICICOLA Ridgway: Willow Thrush

An adult male of the willow thrush, differing from the veery in darker dorsal color and darker spots on the breast, was taken in migration near Uniontown on May 10.

SIALIA SIALIS SIALIS (Linnaeus): Eastern Bluebird

Distributed widely, specimens were obtained as follows: In the isolated sector of Fulton County, south of New Madrid, Mo., separated by a loop of the Mississippi from the rest of Kentucky, June 1; Canton, November 2; South Carrollton, October 18; Waverly, May 12; Brandenburg, April 22 and 29; Roundhill, November 11; Brownsville, November 8; Burlington, October 11; Mount Vernon, October 3; Quincy, July 11. Young in spotted plumage, recently from the nest, were secured at Waverly on May 12 and at 4,150 feet on Black Mountain near Lynch on June 30.

^{*} Bicknell's thrush, its taxonomy, distribution, and life history. Proc. Boston Soc. Nat. Hist., vol. 41, No. 6, Jan. 1930, pp. 238-242.

Family SYLVIIDAE

POLIOPTILA CAERULEA CAERULEA (Linnaeus): Blue-gray Gnatcatcher

These slender little birds are most evident in spring and at the beginning of summer, when they are singing and nesting. Later in the season, when they are more quiet and the leaves are fully developed in the trees, they are observed ordinarily only by chance. Two were collected at Brandenburg on April 21 and 22, and others were seen at Rock Haven on April 26. Another was shot at Coopersville, Wayne County, June 6.

CORTHYLIO CALENDULA CALENDULA (Linnaeus): Eastern Ruby-crowned Kinglet

In spring these birds were taken at Rock Haven on April 26, Brandenburg on April 30, and Waverly on May 16, the last mentioned being an adult female. There is also a specimen collected at Wickland, near Bardstown, April 10, 1882, by C. W. Beckham. The first arrival in fall was secured at 2,800 feet elevation on Log Mountain, near Middlesboro, September 27. Others were shot at Burlington on October 11, South Carrollton on October 18, and Roundhill on November 7.

REGULUS SATRAPA SATRAPA Lichtenstein: Eastern Golden-crowned Kinglet

This handsome little bird was obtained only during fall, the first one being seen at Mount Vernon, Rockcastle County, on October 1. Two days later ten were seen and one was taken. Others were secured at Madisonville on October 24, Canton on November 2, and Brownsville on November 8. An adult male was shot at Lexington, November 17, 1898, by E. A. Mearns.

Family MOTACILLIDAE

ANTHUS SPINOLETTA RUBESCENS (Tunstall): American Pipit

Near Cadiz, Trigg County, two flocks were recorded on November 4, and two specimens were taken.

Family BOMBYCILLIDAE

BOMBYCILLA CEDRORUM Vieillot: Cedar Waxwing

On Black Mountain, southeast of Lynch, Harlan County, the cedar waxwing was fairly common from 3,900 to 4,100 feet, an adult female being taken June 25. Elsewhere waxwings were seen at Brandenburg on April 22 and at Rock Haven on April 25. In fall they were recorded on Log Mountain, near Middlesboro, on September 19 and 22, and specimens were taken at Mount Vernon on October 5, Canton on October 29, and Brownsville on November 12. There is also a speci-

men in the collection from Bardstown, shot on October 22, 1881, by C. W. Beckham. An adult male from Brownsville has red tips on three of the rectrices.

Family LANIIDAE

LANIUS LUDOVICIANUS MIGRANS Palmer: Migrant Shrike

The five specimens at hand, all taken in fall, come from the following localities: Sacramento, October 25; Princeton, November 5; Brownsville, November 12; and Lexington, November 21, 1898 (collected by E. A. Mearns).

Family STURNIDAE

STURNUS VULGARIS VULGARIS Linnaeus: Starling

The aggressive starling was taken at Uniontown on May 10 (young in juvenal plumage) and 13, Brandenburg on April 29, and Monticello on June 4. A flock was seen near Middlesboro on September 29.

Family VIREONIDAE

VIREO GRISEUS GRISEUS (Boddaert): White-eyed Vireo

Specimens were obtained as follows: Hickman, May 25 and 26; Waverly, May 9; Brandenburg, April 22 and 30; Monticello, June 10 and 11; Mount Vernon, October 4; and Middlesboro, September 19. A young bird just from the nest was taken near Hickman on May 25 and another a little older but still in juvenal plumage at Quincy on July 11.

There have been three recent proposals with regard to geographic races in this species in that part of its range included in the Eastern United States. Ridgway⁹ recognized two subspecies, one from the Florida Keys and the coast district of the Florida Peninsula north to Tarpen Springs and Anastasia Island, and another ranging as a breeding bird throughout the Eastern United States to the northward west to the Great Plains. Todd¹⁰ considered that the southern race extended from southern Florida north to South Carolina and through the Gulf States to Louisiana, with the northern form ranging elsewhere to the northward. Oberholser¹¹ recognized three forms, including the two proposed by Todd, with the addition that he differentiates also the one from extreme southern Florida accepted by Ridgway.

On examination of considerable material it is my conclusion that the treatment proposed by Mr. Ridgway is the one that is most logical.

⁹ U. S. Nat. Mus. Bull. 50, pt. 3, 1904, pp. 183-186.

¹⁰ Wilson Bull., 1926, pp. 222-223.

¹¹ Louisiana Dept. Cons. Bull. 28, 1938, pp. 502-503.

The Key West vireo, *Vireo griseus maynardi* Brewster, differs from the bird of the north in grayer dorsal color, in paler and more restricted yellow on sides and flanks, and in slightly larger bill. Breeding specimens from northern Florida and the Gulf States to Louisiana and north to South Carolina in series average very slightly duller yellow on the sides and flanks than those from farther north. The difference is slight and is appreciable only in part of the specimens I have seen, about one-half of those examined being identical from the two areas. In view of the slight amount of the difference and of its variation it does not seem to be practicable to recognize two races in this northern area, so that all the birds of the Eastern United States north of southern Florida should in my opinion be called *Vireo griseus griseus*. The duller birds of the south merely represent intergrades toward the duller colored race *maynardi* of extreme southern Florida.

VIREO FLAVIFRONS Vieillot: Yellow-throated Vireo

Specimens were obtained during the breeding season at Hickman on May 21, Rockybranch on June 13, and Monticello on June 14. Several were found during the fall migration on the slopes of Log Mountain on September 20, 24, and 25.

VIREO SOLITARIUS SOLITARIUS (Wilson): Blue-headed Vireo

One was shot near Morehead on October 8 and another near Sacramento on October 17. These are the only records made pertaining to the northern race of this bird.

VIREO SOLITARIUS ALTICOLA Brewster: Mountain Vireo

On Black Mountain, 4 miles southeast of Lynch, the mountain vireo was common above 3,800 feet, so that six specimens were collected between June 23 and 28. These all have the dark dorsal coloration and longer wing of this southern form. On Log Mountain, 7 miles west of Middlesboro, we found two on September 24, and later Perrygo collected another on September 27. These three birds are still in partial molt on the head and body and are believed to be representative of the nesting birds of this area. The range of this form in Kentucky is necessarily decidedly limited.

VIREO OLIVACEUS (Linnaeus): Red-eyed Vireo

Common and widely distributed, specimens of the red-eyed vireo were collected as follows: Hickman, May 20; Uniontown, May 10; Waverly, May 11; Brandenburg, April 20 and 27; Coopersville, June 3; Rocky Branch, June 7; Log Mountain, near Middlesboro, September 17 and 20; Belfry, Pike County, July 4 and 6; 4,000 feet elevation on Black Mountain, near Lynch, June 27; Quincy, July 12. In fall the last one was recorded near Mount Vernon on October 5.

There are a considerable number of vireos of the general color pattern of the red-eye distributed widely in the warmer portions of the New World that it has been proposed to treat as geographic races of one species. Though it may develop that this is true, it is my own feeling that the evidence is not as yet conclusive, so that for the present I prefer to recognize *olivaceus* as a species distinct from the others. The question is one that is complicated by the fact that even the forms that breed in the West Indies, Mexico, and Central America are migratory, retiring to the south after nesting, so that the actual breeding ranges of some yet remain to be definitely ascertained.

Family COMPSOTHTYPIIDAE

MNIOTILTA VARIA (Linnaeus): Black and White Warbler

Specimens were obtained as follows: Brandenburg, April 28; Coopersville, June 6 (adult and one young fully grown); Rockybranch, June 8; Bardstown, May 9, 1885 (taken by C. W. Beckham); Mount Vernon, October 1; Log Mountain, near Middlesboro, September 24; 4,000 feet elevation on Black Mountain, near Lynch, June 29 (adult and fully grown young). The last one seen in fall was recorded at Mount Vernon on October 3.

PROTONOTARIA CITREA (Boddaert): Prothonotary Warbler

In the northwestern section of the State one was taken 3 miles east of Waverly on May 9. Near Uniontown the birds seemed fairly common, as three were seen and one was collected on May 13. In the cypress swamps 4 miles southwest of Hickman specimens were shot on May 20 and 27, including one young bird just from the nest in the curious, grayish, juvenile plumage.

HELMITHEROS VERMIVORUS (Gmelin): Worm-eating Warbler

An immature male was taken at 2,000 feet elevation on Log Mountain, 8 miles west of Middlesboro, on September 27.

VERMIVORA PEREGRINA (Wilson): Tennessee Warbler

In the spring migration specimens were shot near Waverly on May 6 and near Uniontown on May 10. In fall they were common over the slopes of Log Mountain from September 19 to 23 (specimens taken on each of these dates), and one was collected at South Carrollton on October 26. At Bardstown, Nelson County, specimens were taken on September 13 and 15, 1880, and September 18, 1885, by C. W. Beckham.

VERMIVORA RUFICAPILLA RUFICAPILLA (Wilson): Nashville Warbler

An adult male was shot a mile east of Waverly on May 11. An older record is that of a male taken at Bardstown on April 28, 1877, by C. W. Beckham.

COMPSOTHYLPIS AMERICANA PUSILLA (Wilson): Northern Parula Warbler

The only one taken is an adult male shot on May 31 near the northern arm of Reelfoot Lake, 4 miles southwest of Hickman. This bird is dark above with a broad black band extending across the upper breast. In size it is small as the wing measures only 55.6 mm. This specimen is one of those small, richly colored birds of the type that led to the separation of the Mississippi Valley group in this species as the race *ramalinae*. It seems to me at present too difficult to differentiate except for occasional individuals to allow its separation from *pusilla*.

DENDROICA AESTIVA AESTIVA (Gmelin): Eastern Yellow Warbler

An adult female was collected 7 miles east of Monticello on June 9. One was taken at Bardstown on April 23, 1877, by C. W. Beckham.

DENDROICA MAGNOLIA (Wilson): Magnolia Warbler

Recorded as follows: Uniontown, May 17; Hickman, May 25; and Log Mountain, west of Middlesboro, September 19, 22, and 25.

DENDROICA CAERULESCENS CAERULESCENS (Gmelin): Black-throated Blue Warbler

An adult male was taken at Waverly on May 11. A female shot on Log Mountain, west of Middlesboro, September 22, is also of the northern race as indicated by its paler dorsal coloration.

DENDROICA CAERULESCENS CAIRNSI Coues: Cairns's Warbler

An excellent series of four males and three females taken at elevations ranging from 3,800 to 4,100 feet on Black Mountain, near Lynch, June 20 to 24, show that this is the breeding form from this mountain area. There is also an adult male in the collection from 2,000 feet elevation on Log Mountain, 7 miles west of Middlesboro, collected on September 25. This last bird has no black in the back but is marked by the deep hue of the blue.

DENDROICA CORONATA CORONATA (Linnaeus): Myrtle Warbler

Records for this migrant species are as follows: Brandenburg, April 21 and 22; Burlington, October 11; Madisonville, October 24; South Carrollton, October 24; Canton, October 29; Brownsville, November 8 and 12.

DENDROICA VIRENS VIRENS (Gmelin): Black-throated Green Warbler

Two adult males were taken near Waverly on May 17. In fall specimens were obtained on Log Mountain on September 24 and 28, near Mount Vernon on October 1, and 9 miles northeast of Madisonville on October 24. One was collected at Bardstown on September 16, 1885, by C. W. Beckham.

It was unexpected to secure an adult male 2 miles east of Rockybranch in Wayne County on June 7 and to see others here on June 13 and 14, as well as at a point 7 miles east of Monticello on June 9. Apparently the species nests fairly commonly in this region, which is an extension of the breeding range previously known. The elevation is relatively low. The bird also breeds on Pine Mountain in Letcher County, as an adult male was shot there at 2,300 feet elevation, 4 miles southeast of Whitesburg, June 29.

DENDROICA CERULEA (Wilson): Cerulean Warbler

The first one was seen at Rock Haven, Meade County, on April 26, and a male was taken near Brandenburg on May 2. In Wayne County those birds were common, specimens coming from Rockybranch on June 8 and east of Monticello on June 9 and 10. One was collected at Bardstown, Nelson County, April 13, 1877, by C. W. Beckham. The males in this small series show the usual variation in the breast band from a broad heavily marked collar of mixed slaty black and light blue to a narrow, interrupted line that crosses the white of the upper breast like a necklace.

DENDROICA FUSCA (Müller): Blackburnian Warbler

That the Blackburnian warbler breeds on Black Mountain, near Lynch, is shown by an adult male collected at 4,000 feet on June 23. One was taken at Bardstown on September 11, 1885, by C. W. Beckham.

DENDROICA DOMINICA DOMINICA (Linnaeus): Yellow-throated Warbler

An adult male from Bardstown, Nelson County, taken on April 19, 1877, by C. W. Beckham belongs to the typical race and is to be considered a straggler. The lores are yellow, the white area on the rectrices is extensive, and the culmen from base measures 13.5 mm.

DENDROICA DOMINICA ALBILORA Ridgway: Sycamore Warbler

An adult female was collected 3 miles east of Waverly on May 7. The lores in this bird are entirely white, and the culmen from base measures 15.3 mm.

DENDROICA PENSYLVANICA (Linnaeus): Chestnut-sided Warbler

On Black Mountain, near Lynch, this warbler was common so that several were collected from June 21 to 23 at around 4,000 feet elevation. Others were taken on Log Mountain, near Middlesboro, on September 19 and 22, and there is a specimen in the collection shot at Bardstown on May 2, 1885, by C. W. Beckham.

DENDROICA CASTANEA (Wilson): Bay-breasted Warbler

Over the higher slopes of Log Mountain, near Middlesboro, these birds were abundant from September 19 to 22, three being taken. There is also one collected on September 15, 1880, at Bardstown by C. W. Beckham.

DENDROICA STRIATA (Forster): Black-poll Warbler

The black-poll was seen at Uniontown on May 13, and specimens were taken at Corydon on May 14 and Waverly on May 16. One was shot at Bardstown on May 8, 1882, by C. W. Beckham.

DENDROICA PINUS PINUS (Wilson): Northern Pine Warbler

An adult male was taken 3 miles south of Coopersville on June 6, and others were seen in the region east of Monticello on June 9 and 10.

DENDROICA DISCOLOR DISCOLOR (Linnaeus): Northern Prairie Warbler

The first arrivals from the south were recorded 5 miles northwest of Brandenburg on April 22, when male and female were taken. Males were shot subsequently at Monticello on June 15 and near Stearns on June 16. In fall one was collected near Middlesboro on September 28. There is also a specimen in the Museum from Bardstown taken on April 26, 1882, by C. W. Beckham.

DENDROICA PALMARUM PALMARUM (Gmelin): Western Palm Warbler

In spring the bird was noted only at Waverly, where a female was shot on May 6. In fall three specimens were taken on Log Mountain, west of Middlesboro, at elevations of 2,800 to 2,900 feet on September 21 and 22, and one near the town of Middlesboro on September 29. Subsequently, two were secured 6 miles west of Burlington on October 10.

SEIURUS AUROCAPILLUS (Linnaeus): Ovenbird

The present species was collected during the breeding season at Coopersville on June 6, Rocky Branch on June 7, and 4,000 feet elevation on Black Mountain, near Lynch, on June 28. From September 21 to 27 these birds were common over the slopes of Log Mountain, west of Middlesboro. There is also a specimen in the Museum from the Edward J. Brown collection taken at Louisville September 4, 1884, by William Palmer.

SEIURUS NOVEBORACENSIS NOVEBORACENSIS (Gmelin): Northern Water-thrush

An adult female taken at Uniontown on May 10 belongs to the eastern form as shown by its brownish dorsal color and small size (wing 69 mm.). A water-thrush of undetermined race was seen at Middlesboro on September 28.

SEIURUS NOVEBORACENSIS NOTABILIS (Ridgway): Grinnell's Water-thrush

On May 9 an adult male was shot 3 miles east of Waverly. This bird is typical of the western race in darker gray, less brownish dorsal coloration. The wing measures 75.1 mm.

SEIURUS MOTACILLA (Vieillot): Louisiana Water-thrush

Specimens were obtained at Rock Haven April 25, and 7 miles east of Monticello June 9. One was taken at Bardstown on April 23, 1877, by C. W. Beckham.

OPORORNIS FORMOSUS (Wilson): Kentucky Warbler

This handsome bird, named for the State from which these specimens come, was taken at Hickman on May 24 and 30 and near Monticello on June 9 and 15.

GEOTHLYPIS TRICHAS BRACHIDACTYLA (Swainson): Northern Yellow-throat

The first bird of the season was a male from 4 miles southeast of Brandenburg shot on April 27. Specimens collected at Waverly on May 6 and 7 and Uniontown on May 10 may have been summer residents or migrants. A male and two females from near the northern arm of Reelfoot Lake taken on May 20, 21, and 25 are to be considered breeding birds, as are specimens from Monticello, June 15, 3,900 to 4,100 feet elevation on Black Mountain, near Lynch, June 23, 24 and 30, and 5 miles northeast of Quincy, July 11 and 12. The last mentioned include a juvenile bird not quite grown. Males in this series have wing measurements ranging from 52.2 to 55.8 mm., all but 4 being more than 54 mm. All have a definite spread of yellow across the lower breast and abdomen, and all are bright green above.

In fall birds were taken at 2,800 feet on Log Mountain, near Middlesboro, on September 21, at Mount Vernon on October 4, and at South Carrollton on October 22. These are definitely yellow below.

All the birds seen from the State are referred to the race *brachidactyla* as understood at present.

ICTERIA VIRENS VIRENS (Linnaeus): Yellow-breasted Chat

Specimens were obtained as follows: Near Hickman, May 20 and 24; Waverly, May 7 and 9; 3,900 to 4,100 feet elevation on Black Mountain, near Lynch, June 23, 24, and 29; and Belfry, Pike County, July 4.

Two males from 4 miles southwest of Hickman, Fulton County, agree with specimens from near Reelfoot Lake in Tennessee in having the white of the malar region slightly more extensive than those seen from elsewhere in Kentucky and Tennessee. A male taken

near Waverly (U. S. N. M. No. 337821) has a white mark on the posterior part of the superciliary region and extensive yellow markings on the scapulars and greater wing coverts. Curiously enough, I saw a yellow-breasted chat with similar markings, but with the white on the head much more extensive, several times about our camp at Tres Zapotes, southern Veracruz, Mexico, in March and early in April 1939.

WILSONIA CITRINA (Boddaert): Hooded Warbler

The first one of the season was seen at Rock Haven, Meade County, April 26. Specimens were taken at Hickman on May 30, at 3,800 feet elevation on Black Mountain, near Lynch, on June 22, and on Log Mountain, near Middlesboro, on September 21 and 22.

WILSONIA PUSILLA PUSILLA (Wilson): Wilson's Warbler

An adult male taken on May 16 comes from 3 miles east of Waverly, in Union County.

WILSONIA CANADENSIS (Linnaeus): Canada Warbler

On the summit of Black Mountain, near Lynch, the Canada warbler was fairly common. The three specimens obtained were taken at 3,800 and 3,900 feet elevation on June 20, 23, and 24. The last mentioned is a juvenile bird barely grown.

SETOPHAGA RUTICILLA (Linnaeus): Redstart

Specimens were taken at the following places: Hickman, May 20 and 27; Waverly, May 6 and 9; Uniontown, May 13; Monticello, June 9; Bardstown, April 24, 1877 (collected by C. W. Beckham); Mount Vernon, October 1; Log Mountain, near Middlesboro, September 23; 4,100 feet elevation on Black Mountain, near Lynch, June 21; and Quincy, July 11.

Oberholser¹² has recognized a western race of the redstart, using for it the name *tricolora* of Müller and stating that "this western race differs from the eastern form in smaller size, smaller orange or yellow wing-spot; in the female also in paler, more grayish, less conspicuously olivaceous, upper surface."

To check this I have examined a large series of redstarts from the entire breeding range of the species, and so far as I can determine there are no definite characters that will allow the segregation of two subspecies. Measurements of males taken from birds on or near their breeding grounds from east and west are as follows (averages given in parentheses):

¹² Louisiana Dept. Cons. Bull. 28, 1938, pp. 572-573.

Twenty-eight specimens from Newfoundland, Nova Scotia, Massachusetts, New York, and Pennsylvania, wing 62.7–66.9 (65.0), tail 52.4–58.4 (55.4), culmen from base 10.2–12.6 (11.1), tarsus 16.0–18.1 (17.6) mm.

Eighteen specimens from Mackenzie, Athabaska, Alberta, Washington, Montana, and South Dakota, wing 61.5–65.1 (63.6), tail 53.5–59.2 (56.5), culmen from base 10.0–11.9 (10.4), tarsus 15.8–18.0 (17.0) mm.

With length of wing taken for a criterion, it may be noted that while the smallest bird comes from the west (being a specimen taken on Slave River, Athabaska, 10 miles below Peace River, June 15, 1901) the difference between it and the smallest eastern bird measured (a male from Locust Grove, Pa., taken on June 27, 1895) is only 1.2 mm., while the largest eastern bird exceeds the largest western skin by only 1.8 mm. Though the western series averages very slightly smaller, this difference for the two groups is only 1.4 mm. It is obvious that there is so much overlap that the identification of specimens on the basis of larger or smaller size, except for a very few specimens, can only be by arbitrary decision.

With regard to the wing spot, the basal portion of the secondaries, except the innermost, and of the primaries, except the outermost, is orange in the adult male and yellow in the female and immature male. The wing spot is most prominent in the male as it averages larger than in the female, in addition to being brighter colored. The extent to which this orange is exposed is governed by the amount of coverage by the overlying greater coverts and primary coverts. In examining a considerable series of birds I find much variation in the apparent size of this wing spot but cannot correlate this variation with definite geographic area. It appears to me that one factor in the apparent size of this wing spot is due to the method used by the collector in preparing specimens. Many follow the practice—one that to me has always seemed pernicious and that I have never followed—of loosening the secondaries from the ulna in cleaning the flesh from the wing. In the finished specimen this may easily change the relation between the secondaries and the coverts overlying their bases, and in the case of these redstarts may modify the apparent size of the exposed section of orange color that constitutes the wing spots.

Finally I am not able to detect differences in dorsal color in females from the eastern and western areas.

Family ICTERIDAE

STURNELLA MAGNA MAGNA (Linnaeus) : Eastern Meadowlark

The meadowlarks of Kentucky offer some difficulty in identification since in the south and west there are birds intermediate between the

eastern and the southern forms, the latter ranging into the southwestern section of the State. In a pair from Corydon, Henderson County, taken on May 14, the wing in the male is 123.5 mm. and in the female 109.8 mm. They are rather deep yellow below, in this seeming slightly intermediate toward the southern form, and are a little dark above. While slightly intermediate they belong with the northern bird. An adult male from Brandenburg, taken on April 30, with the wing 122.4 mm., is similar to them, as is a male taken at Bardstown, April 14, 1877, by C. W. Beckham, which has the wing 120 mm. Two fall males, shot 11 miles south of Brownsville on November 11, which measure 118.4 and 118.9 mm., are also rather bright below, though lighter above. A breeding male collected 4 miles east of Monticello on June 16, with the wing 117.3, is definitely intermediate in its brighter breast and is placed somewhat arbitrarily with *magna*. More material is desirable from this area to settle the status of its breeding birds. A female from Mount Vernon, secured on October 5, is light in color and has the wing 105.3 mm. An adult female from Middlesboro, September 29, measures 106.9 mm. A juvenile bird just from the nest was collected at Fullerton, Greenup County, on July 13.

STURNELLA MAGNA ARGUTULA Bangs: Southern Meadowlark

This race of meadowlark, distinguished by small size, brighter yellow below, and darker hue above, is found in southwestern Kentucky. An adult male shot on June 1 on the banks of the Mississippi, in the small section of Fulton County that lies in a loop of the river south of New Madrid, Mo., is distinctly bright yellow below and dark above and has the wing 112 mm. Another male taken on May 30 about 4 miles southwest of Hickman, with the wing measuring 116.8, is even darker above and brighter below. Fall specimens include two males from Trigg County that also are identified as the southern race. One from Canton, November 2, measures 116.8, and one from 5 miles northeast of Golden Pond, November 3, has the wing 115.3. The color in these two is deep. Two males obtained 9 miles northeast of Madisonville on October 21, which measure 116 and 116.8 mm., also belong in this series. The limit of the ranges between the two forms in southwestern Kentucky thus is indicated, though further collecting is necessary to determine the northern limit of the race *argutula*.

AGELAIUS PHOENICEUS PHOENICEUS (Linnaeus): Eastern Red-wing

A fair series obtained both in the breeding season and in the time of fall migration contains only specimens of this form. Records are as follows: 4 miles southwest of Hickman, near the northern ex-

tremity of Reelfoot Lake, May 23 and 24; Waverly, May 11 and 12 (the last a male in the immature stage where the epaulets are almost wholly black); Roundhill, November 12; Rock Haven, April 25; Ghent, October 13; Burlington, October 13; Berea, October 4; and Quincy, July 13.

ICTERUS SPURIUS (Linnaeus): Orchard Oriole

An adult male was taken 4 miles west of Stearns on June 16.

EUPHAGUS CAROLINUS (Müller): Rusty Blackbird

A male comes from Roundhill, Butler County, November 11.

QUISCALUS VERSICOLOR Vieillot: Bronzed Grackle

Specimens were obtained as follows: Hickman, May 31; Waverly, May 12; Roundhill, November 11 and 12; and Quincy, July 13 (including one juvenile bird fully grown).

These are all typical of the bronzed grackle as would be expected from the area covered. Elsewhere¹³ I have indicated my reasons for considering this bird as specifically distinct from the purple grackles of more eastern range, and for using the name *versicolor* Vieillot instead of *aeneas* Ridgway. My good friend Dr. Frank M. Chapman¹⁴ has objected to this on the ground that the specimen in the Paris Museum may not be the actual type of Vieillot's description. While I hesitate to disagree, especially since Dr. Chapman has devoted so much careful study to these grackles, I find it necessary after a second review of the question to hold to my former statement.¹⁵

MOLOTHRUS ATER ATER (Boddaert): Eastern Cowbird

The wide distribution of the cowbird during the nesting season is indicated by the following records: On the Mississippi River in extreme western Fulton County, in the area cut off from the rest of the State and south of New Madrid, Mo., June 1; Waverly, May 7; Rock Haven, April 26; Belfry, July 5 (immature); Quincy, July 12 (immature); and Fullerton, July 13. The last is an immature male molting into first fall plumage.

Family THRAUPIDAE

PIRANGA ERYTHROMELAS Vieillot: Scarlet Tanager

The first scarlet tanagers of the spring were seen near Brandenburg on April 21. Specimens are at hand from Uniontown, May 13;

¹³ Proc. U. S. Nat. Mus., vol. 86, 1939, pp. 230-231.

¹⁴ Auk, 1939, pp. 364-365.

¹⁵ See Auk, 1939, pp. 505-506.

Bardstown, May 7, 1881 (taken by C. W. Beckham); 4,100 feet elevation on Black Mountain, 4 miles southeast of Lynch, June 21; and 2,800 feet elevation on Log Mountain, 7 miles west of Middlesboro, September 17.

PIRANGA RUBRA RUBRA (Linnaeus): Summer Tanager

Specimens were taken at the following localities: Near Hickman, May 26; Brandenburg, May 3; Coopersville, June 6; Bardstown, May 7, 1877 (shot by C. W. Beckham); and Belfry, July 8. They were seen on Log Mountain, west of Middlesboro, on September 21, and near Mount Vernon on October 1.

Family FRINGILLIDAE

RICHMONDENA CARDINALIS CARDINALIS (Linnaeus): Eastern Cardinal

The cardinal was recorded in all localities visited except on the higher elevations of Black Mountain in Harlan County. Specimens were obtained as follows: Hickman, May 20 and 24; Golden Pond, November 3; Canton, October 29; Uniontown, May 5; Waverly, May 6; Madisonville, October 20; South Carrollton, October 18; Roundhill, November 11; Brandenburg, April 20; Rock Haven, April 26; Burlington, October 11; Rockybranch, June 8 (young bird recently from nest) and 14; Monticello, June 9; Mount Vernon, October 4; 2,000 feet elevation on Log Mountain, Bell County, September 27; Middlesboro, September 28; Belfry, July 4 (young bird recently from nest) and 5; and Quincy, July 11.

HEDYMELES LUDOVICIANUS (Linnaeus): Rose-breasted Grosbeak

In spring specimens were taken at Brandenburg on April 30 and at Uniontown on May 10. They were fairly common as breeding birds on the summit of Black Mountain, near Lynch, where a male was collected on June 21. Three were taken and others were seen on Log Mountain, west of Middlesboro, on September 19, 20, and 23, and the last of the season was secured at Mount Vernon on October 4.

PASSERINA CYANEA (Linnaeus): Indigo Bunting

In the summer season the indigo bunting is distributed throughout the State. Specimens were secured as follows: Hickman, May 27; Uniontown, May 5; Waverly, May 11; Brandenburg, April 29; Monticello, June 10; Coopersville, June 6; Mount Vernon, October 3 and 4; 2,300 feet elevation on Pine Mountain, near Whitesburg, June 29; Quincy, July 12.

SPIZA AMERICANA (Gmelin): Dickcissel

Throughout the open country of western Kentucky the dickcissel is one of the common summer residents seen constantly in travel along the roads. Specimens were obtained as follows: Hickman, May 20, 23, and 31; Waverly, May 6, 7, and 11; and Corydon, May 14.

CARPODACUS PURPUREUS PURPUREUS (Gmelin): Eastern Purple Finch

In fall the purple finch was found at Roundhill, Butler County, on November 7 and 12, two adult males and a female being taken. One was collected at Bardstown on April 11, 1877, by C. W. Beckham.

SPINUS PINUS PINUS (Wilson): Northern Pine Siskin

Two were taken on October 27 near South Carrollton. Later a flock was recorded on November 12 near Brownsville.

SPINUS TRISTIS TRISTIS (Linnaeus): Eastern Goldfinch

Near Brandenburg goldfinches in molt from winter to summer dress were taken April 23 and May 3. One from Waverly collected on May 6 is just completing this molt. Summer birds were taken at Monticello on June 10 and 15, at 3,800 feet elevation on Black Mountain on June 23, and near Quincy on July 12. A juvenile bird recently from the nest and an adult male in worn plumage were collected at 2,800 feet on Log Mountain, 7 miles west of Middlesboro, on September 21, and other young birds in postjuvinal molt were secured at Burlington on October 11. Specimens in winter dress include one from South Carrollton, October 27; two from Roundhill, November 7; and one from Lexington, November 17, 1898 (taken by E. A. Mearns).

LOXIA CURVIROSTRA Linnaeus: Red Crossbill

There is in the National Museum an adult male red crossbill, taken at Bardstown in March 1883 by C. W. Beckham, that agrees with Ludlow Griscom's description of *Loxia curvirostra neogaea*.¹⁶ It is dull red in color and has the following measurements: Wing 91, tail 52.2, culmen from base 17.3, depth of bill 9.2, tarsus 16.5 mm.

PIPILO ERYTHROPHthalmus ERYTHROPHthalmus (Linnaeus): Red-eyed Towhee

Although two forms of towhee are found in Tennessee, the Alabama towhee (*Pipilo e. canaster*) ranging in the southeastern and eastern sections north to Shady Valley, the birds of Kentucky are all to be classed as the typical form. The only suggestion of the more south-

¹⁶ *Loxia curvirostra neogaea* Griscom, Proc. Boston Soc. Nat. Hist., vol. 41, Jan. 1937, pp. 93, 110 (Lake Umbagog, Maine).

ern race is found in three immature male birds taken on the summit of Log Mountain, all being in molt from juvenal to first fall plumage. In these the color of the flanks is very faintly paler than normal, indicating some faint trace of the influence of the more southern form.

Specimens were obtained as follows: Waverly, May 7 and 9; Canton, October 31; Madisonville, October 20; Roundhill, November 7; Brandenburg, April 22 and 23; Ghent, October 11; English, October 12; Mount Vernon, October 3; Morehead, October 8; 2,800 feet elevation on Log Mountain, 7 miles west of Middlesboro, September 17; 2,300 feet elevation on Pine Mountain, near Whitesburg, June 29 (juvenile); and 4,000 and 4,100 feet elevation on Black Mountain, near Lynch, June 21, 22, and 23.

PASSERCULUS SANDWICHENSIS SAVANNA (Wilson): Eastern Savannah Sparrow

The material recently collected from the eastern part of the Mississippi drainage, including birds from West Virginia, Tennessee, and Kentucky, has made it important to review the entire collection from the eastern United States in the National Museum in accordance with the new understanding of the geographic races of this interesting bird offered in the excellent study published recently by James L. Peters and Ludlow Griscom.¹⁷ The work has involved many days of careful consideration, and through a clearer understanding has changed a few of the identifications published in my recent studies on birds from West Virginia and Tennessee. In the present report therefore I have listed all this material again to bring the record down to date. As Peters and Griscom have indicated, identification of geographic races in this species, though highly interesting, is much involved, and requires careful comparison of series of specimens taken at the same season of the year. In the present investigation the entire lot of birds was assorted by months so that birds of exactly comparable stage of plumage could be examined together.

After going into the question with much care I am still of the opinion expressed earlier¹⁸ that the Ipswich sparrow is specifically distinct from the Savannah sparrows proper.

In modern application of trinomial nomenclature the tendency of some workers seems to be to replace the species concept with its division into geographic races with the "formenkreis" concept, and to use the latter as the unit in nomenclature, differentiating all its included forms by use of a third term in the scientific name. While

¹⁷ Geographical variation in the Savannah sparrow. Bull. Mus. Comp. Zool. vol. 80, Jan. 1938, pp. 445-478, 1 pl.

¹⁸ Wetmore, A., Proc. U. S. Nat. Mus., vol. 86, 1939, pp. 236-237.

in many cases the formenkreis and the species unit may coincide, in others the formenkreis may include units that are truly separate specific entities, as well as those that cover intergrading geographic races. It is only confusing and misleading to label distinct species with a trinomial in the same manner as very slightly differentiated subspecies. In some cases, in fact, the formenkreis may have the same value as the subgenus, from a nomenclatural standpoint. In the present case the Ipswich sparrow should continue to be listed as *Passerculus princeps*.

With the rest of the conclusions reached by Peters and Griscom with regard to eastern forms of the Savannah sparrow I am in accord, though I believe that the material available now indicates a slightly different understanding of the distribution of the far northern forms. Disregarding for the moment the very gray race *nevadensis*, which breeds from British Columbia, east of the Cascade Range, to Alberta, Saskatchewan, Manitoba, and eastward to Minnesota and southern Wisconsin, the two authors in question have recognized two very dark forms heavily marked with black. One of these, *oblitus* from the western side of Hudson Bay, has the dorsal surface, aside from the very black dark markings, distinctly gray. The other, *labradorius*, is as definitely brown. The race *labradorius* seems to have its maximum expression in deep brown color in birds that I have seen from Fort Chimo, in northern Ungava, while toward the southeast in Labrador and Newfoundland it begins to intergrade with the more southern form, *savanna*. This seems to indicate a wider breeding range for *labradorius* than previously supposed to the west of Labrador, from which area many of the very dark brown birds migrate southward into the Mississippi Valley. Here they mingle with the grayer dark birds *oblitus* that are migrant from areas farther west. This conception gives a more extended winter range to *labradorius*, as Peters and Griscom have reported this form in fall, winter, and spring mainly along the Atlantic seaboard.

The race *savanna* is marked by lighter-brown dorsal plumage, with the sides of the head paler, and the spots and streaks on the under surface somewhat reduced and in the main dark brown.

The following specimens from Kentucky are identified as *P. s. savanna*: Cerulean, November 5; Canton, November 2; Madisonville, October 24; South Carrollton, October 24, 25, and 27; Roundhill, November 12; Bardstown, March 3, 1882 (taken by C. W. Beckham); Berea, October 6; and Richmond, October 4.

West Virginia specimens are as follows: Big Burn, near Yokum Knob, Middle Mountain, July 4, 1936; 3,200 feet elevation on Flat Top Mountain, near Flat Top, October 15, 1936. (The remaining

specimen recorded originally as *savanna*¹⁹ proves now to be *labradorius*.)

Tennessee: Rockwood, March 18, 21, and 31, 1885, taken by A. H. Fox. (The birds recorded²⁰ as taken on April 7, 1885, by A. H. Fox prove to be *labradorius*, while the two reported from Bartlett, April 19, 1937, are *oblitus*. There is also a specimen of *oblitus* shot at Rockwood March 31, 1885, by A. H. Fox.)

PASSERCULUS SANDWICHENSIS LABRADORIUS Howe: Labrador Savannah Sparrow

This race is marked by very dark color, with heavier and more prominent black markings above, the feathers being bordered with darker brown, the sides of the head darker, the edgings of the remiges usually very rich dark brown, and the spots and streaks of the under surface abundant and usually deep black in color. Specimens from Kentucky include the following: 6 miles northwest of Brandenburg, May 3; Mount Vernon, October 3 and 6; Berea, October 6; South Carrollton, October 18 and 22; and Canton, November 1.

From West Virginia, in addition to the specimen taken November 2, 1936, at Mercers Bottom identified originally as *labradorius*, it now appears that another taken at this same place on October 29 belongs to this same race.

From Tennessee two skins from Rockwood collected on April 7, 1885, by A. H. Fox belong here, the form *labradorius* being an addition to the list of birds in my recent report on collections from that State.

While *Passerculus sandwichensis oblitus* Peters and Griscom is not represented in the present collection from Kentucky, it will undoubtedly be found there as a migrant.

PASSERCULUS SANDWICHENSIS NEVADENSIS Grinnell: Nevada Savannah Sparrow

This race is much paler gray above, with the black markings reduced above and below, the sides of the head paler, the yellow over the eye lighter and less in amount, and the bill usually more slender. Peters and Griscom have extended the breeding range of this well-marked form east to southern Wisconsin.

An immature male taken at South Carrollton on October 22 is entirely characteristic of this well-marked form.

Two were taken in Tennessee, at Ellendale on April 17 and at Bartlett on April 19, these having been recorded by me originally as *oblitus*. They now prove to be *nevadensis*.

¹⁹ Proc. U. S. Nat. Mus., vol. 84, 1937, p. 436.

²⁰ Proc. U. S. Nat. Mus., vol. 86, 1939, p. 236.

AMMODRAMUS SAVANNARUM AUSTRALIS Maynard: Eastern Grasshopper Sparrow

The first arrival in spring was recorded at Brandenburg on April 20, and on April 27 a male was taken 4 miles southeast of that town. A colony was located in June 4 miles east of Monticello, and two adult males and a young bird able to fly were obtained on June 11. Other males were collected 5 miles northeast of Quincy on July 11 and at Fullerton on July 12.

AMMODRAMUS SAVANNARUM BIMACULATUS Swainson: Western Grasshopper Sparrow

On April 30 an adult male of the western form of the grasshopper sparrow was taken 6 miles northwest of Brandenburg. As another secured 10 miles to the southeast is the eastern form, this bird must be a migrant enroute to some breeding ground to the northwest. Further studies should be made to determine whether the western race is regularly present in migration in western Kentucky.

PASSERHERBULUS CAUDACUTUS (Latham): LeConte's Sparrow

At dusk on October 24 a little over a mile west of South Carrollton a little flock of these birds flew into a growth of bush-clover (*Lespedeza*) in a lowland field. The three specimens taken constitute one of the interesting finds of the work of the fall season.

POOECETES GRAMINEUS GRAMINEUS (Gmelin): Eastern Vesper Sparrow

The vesper sparrow was seen at Brandenburg on April 20. In fall migration specimens were taken at Bedford on October 13, Golden Pond on November 3, and Cadiz on November 4.

CHONDESTES GRAMMACUS GRAMMACUS (Say): Eastern Lark Sparrow

The only lark sparrow from Kentucky available is a male taken at Wickland estate, near Bardstown, Nelson County, April 25, 1877, by C. W. Beckham.

AIMOPHILA AESTIVALIS BACHMANI (Audubon): Bachman's Sparrow

The only specimen obtained is a male shot 6 miles northwest of Brandenburg on April 21. This bird is identified as *bachmani* though it is somewhat intermediate toward the more western race, *illinoensis*.²¹

JUNCO HYEMALIS HYEMALIS (Linnaeus): Slate-colored Junco

This common winter resident and migrant was obtained as follows: Ghent, October 14; Madisonville, October 20; Canton, October 29 and 31; and Roundhill, November 7.

²¹ See Wetmore, A., Proc. U. S. Nat. Mus., vol. 86, 1939, p. 238.

JUNCO HYEMALIS CAROLINENSIS Brewster: *Carolina Junco*

Perrygo found this race of the junco fairly common at 3,800 feet and above on Black Mountain, near Lynch, and prepared six specimens on June 20, 21, 22, and 29. These have the more uniform gray color, with the head similar to the back, that marks this southern mountain subspecies. Measurements are as follows: Males (4 specimens), wing 76.8, 77.3, 79.4, 80.5, tail 64.3, 66, 66.3, 70.3, culmen from base 11.7, 12.5, 12.8, 13.2, tarsus 21.2, 22.4, 22.4, 22.7 mm. Females (2 specimens), wing 72.4, 73.6, tail 61.8, 63.8, culmen from base 12.3, 12.7, tarsus 21.3, 22 mm.

Whether this junco nests elsewhere along the eastern boundary of the State and its complete range within Kentucky should be ascertained.

SPIZELLA PASSERINA PASSERINA (Bechstein): *Eastern Chipping Sparrow*

Specimens were obtained as follows: Cadiz, November 4; Brandenburg, April 23 and 30; Bedford, October 13; Rockybranch, June 8 and 13; Monticello, June 16; and Middlesboro, September 28. One of the birds from Bedford collected on October 13, an immature male, is very much lighter above than the majority of eastern birds taken at the same season, offering thus a definite resemblance to *S. p. arizonae* in fall dress. On close examination, however, the Bedford bird is deeper buffy brown than the western form. I have seen a few other specimens from eastern localities that resemble it.

SPIZELLA PUSILLA PUSILLA (Wilson): *Eastern Field Sparrow*

The field sparrows of Kentucky are typical of the eastern form until the extreme western border of the State is reached. An adult female collected on June 1, in the segment of Fulton County separated from the rest of the State by a loop of the Mississippi River, is very slightly paler above, showing thus a faintly intermediate condition toward the western race, *arenacea*. One fully grown, in juvenal plumage, shows the same characteristics as the adult. Both, however, are to be classed as *pusilla*.

Other records are as follows: Waverly, May 7 and 9; Canton, October 31 and November 2; Madisonville, October 20 and 24; Brownsville, November 8; Brandenburg, April 20, 21, and 22; Burlington, October 11; Bedford, October 13 (partial albino); Ghent, October 14; Monticello, adult male June 11, juveniles June 10 and 15; Lexington, November 17, 1898 (taken by E. A. Mearns); Mount Vernon, October 3; Middlesboro, September 28; at 3,900 to 4,100 feet elevation on Black Mountain, near Lynch, June 22, 24 (juvenile), and 28; Belfry, July 6 (juveniles).

ZONOTRICHIA LEUCOPHRYS LEUCOPHRYS (Forster) : White-crowned Sparrow

The records obtained for this interesting sparrow were all made in fall. The first seen were two immature females collected October 10 on the banks of the Ohio River 6 miles west of Burlington. Near Ghent on October 14 an adult female was shot and several others were seen. One was collected 9 miles northeast of Madisonville on October 21, and near Canton the birds were common from October 31 to November 2, one being taken on the last date mentioned.

ZONOTRICHIA ALBICOLLIS (Gmelin) : White-throated Sparrow

In spring two males were collected near Brandenburg on April 20 and 21, the birds being common at the time. The first in fall was recorded at Mount Vernon on October 2. Specimens were taken at English on October 12, Madisonville on October 20, Canton on October 29 and November 2, and Brownsville on November 8. The birds were abundant at Roundhill on November 9.

PASSERELLA ILIACA ILIACA (Merrem) : Eastern Fox Sparrow

Specimens of the fox sparrow were taken at South Carrollton on October 24, Cerulean on November 5, and Roundhill on November 7.

MELOSPIZA LINCOLNII LINCOLNII (Audubon) : Lincoln's Sparrow

One was shot 2 miles north of Mount Vernon, Rockcastle County, on October 4.

MELOSPIZA GEORGIANA GEORGIANA (Latham) : Eastern Swamp Sparrow

In his recent work on the birds of Louisiana Dr. Oberholser ²² has separated a western race of the swamp sparrow, a proposal that appears to me valid after examination into it. The birds from the eastern part of the range of the species are darker above, with the brown more reddish, and the gray of the sides and hindneck darker. In fall plumage, when the colors are deeper in tone, distinctness in the shade of gray frequently disappears, but the darker color of the upper surface in general serves to separate birds of the east.

In the material from Kentucky the following are identified as the eastern race: Madisonville, October 24; Brandenburg, April 23; Round Hill, November 7; Burlington, October 7; Berea, October 5; and Mount Vernon, October 5 and 6.

In view of this recognition of two forms I have examined the specimens secured in West Virginia in 1936 and in Tennessee in 1937 with the result that the following records pertain to the eastern bird:

²² Louisiana Dept. Cons. Bull. 28, 1938, p. 675.

West Virginia (taken in 1936 unless otherwise noted): Middle Mountain, 12 miles northeast of Durbin, June 29; Middle Mountain, near Yokum Knob, July 4; Cranberry Glades, June 11 and 12; Ash-ton, October 31; 2,000 feet elevation on Cherry Pond Mountain, near Arnett, October 23; Orgas, October 24; 3,800 feet elevation on Cheat Mountain, 3 miles west of Cheat Bridge, September 25; Cheat Bridge, October 1, 1935; and 3,000 feet elevation on Williams River, Pocahontas County, October 3.

Tennessee (taken in 1937 unless otherwise noted): Hickory Withe, April 10; Reelfoot Lake, 2 miles east of Phillippy, October 12; 6 miles east of Pulaski, November 4; Rockwood, March 19, 20, and 23, 1885.

MELOSPIZA GEORGIANA ERICRYPTA Oberholser ²²: Western Swamp Sparrow

As indicated above the swamp sparrow of the western area of the general range may be separated on the basis of lighter coloration above, the brown of rump and back being distinctly lighter, with the brownish edgings of the dorsal feathers paler and the gray of the hindneck and sides of the neck paler. In fall these birds are also lighter in color, especially on the rump and upper tail coverts. As stated in the account of the eastern form the gray hues in fall are somewhat darker, so that there is sometimes no distinction here.

These differences I have worked out from comparison of 10 breeding males from West Virginia, western Pennsylvania, and Massachusetts and 7 from Alberta (the type locality) and Mackenzie. The characters once established are evident in migrant birds, but I am not prepared at present to attempt to outline the distribution. Oberholser's statement that the western birds are smaller is not borne out by measurements that I have made, the two groups being practically identical.

Following are specimens obtained as migrants in Kentucky that I have assigned to this race: Canton, October 31; South Carrollton, October 18 and 24; Roundhill, November 7 and 11; and Brandenburg, April 23.

The following specimens from West Virginia pertain to this form (taken in 1936): Huntington, May 2; Barboursville, October 26; Mercers Bottom, October 30 and November 2; and 2,900 feet elevation on Flat Top Mountain near Ghent, October 14.

From Tennessee the following were obtained (taken in 1937 unless otherwise noted): Hickory Withe, April 10 and 16; 3 miles north of Tiptonville, October 16; Reelfoot Lake, 2 miles east of Phillippy, Oc-

²² *Melospiza georgiana ericrypta* Oberholser, Louisiana Dept. Cons. Bull. 28, 1938, p. 675 (Fort McMurray, Alberta).

tober 23; Dover, October 26; 6 miles east of Frankewing, November 4; Rockwood, March 19, 1885.

MELOSPIZA MELODIA EUPHONIA Wetmore: Mississippi Song Sparrow

The abundant song sparrow is found throughout the State, all of a long series of specimens obtained belonging to the present form. Following are localities at which it was collected: Ohio River, near Uniontown, May 5; Canton, October 29 and November 1; Madisonville, October 20 and 21; South Carrollton, October 27; Brandenburg, May 2; Roundhill, November 7, 9, and 11; Bardstown, September 21, 1881 (taken by C. W. Beckham); Lexington, November 17, 1898 (taken by E. A. Mearns); English, October 12; Bedford, October 13; Burlington, October 10; Mount Vernon, October 3 and 4; Middlesboro, September 28; Cumberland, June 25; and Quincy, July 11 and 12.



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SEVEN NEW SPECIES AND ONE NEW GENUS OF
HYDROIDS, MOSTLY FROM THE ATLANTIC OCEAN

By C. McLEAN FRASER

SOME time ago the United States National Museum forwarded to me for examination a large collection of hydroids taken mostly by the United States Bureau of Fisheries from the North American coastal area of the Atlantic Ocean. As yet only about one-third of the material has been examined, but this has provided nearly 600 distribution records of 127 species. At this stage it would not be expedient to assemble and digest these distribution records, but it might be a good time to report and describe the new species already observed. There are seven of these species, one of them apparently belonging to a new genus, and a gonosome of a species in which the trophosome has already been described. All but one of these were obtained from the Atlantic. The exception, *Diphasia crassa*, appeared in dredged material obtained on the west coast of Chile, a short distance north of the western entrance to the Strait of Magellan.

I wish here to express my appreciation of the courtesy shown by the United States National Museum in providing the opportunity to examine this interesting material. I am indebted, as well, to Miss Ursula Dale, assistant in the department of zoology in the University of British Columbia, for drawing the figures.

Genus EUDENDRIUM Ehrenberg**EUDENDRIUM RUGOSUM, new species**

PLATE 32, FIGURE 1

Trophosome.—Colonies growing in close clusters, reaching a height of 15 mm.; stems simple, not annulated, but decidedly wrinkled.

throughout, as are also the branches and pedicels. Branches leave the stem at an acute angle and pass upward in the same general direction as the stem; pedicels for the hydranths forming an acute angle with the branches.

Gonosome.—Male gonophores borne on pedicels arising from the main stem or the branches in a whorl, around the base of an aborted hydranth; 3-chambered. Female gonosome not observed.

Type.—U.S.N.M. No. 43433. Taken by the United States Fisheries steamer *Albatross* southeast of Newfoundland, latitude 46°53' N., longitude 44°39'30'' W., 76 fathoms, August 11, 1886.

Genus CAMPANULARIA Lamarck

? CAMPANULARIA ABYSSA, new species

PLATE 32, FIGURE 2

Trophosome.—Colony 2 cm. high; stem simple, slender, not extensively branched, usually one branch from a node, but sometimes two opposite branches, making a wide angle with the stem; hydrothecae regularly alternate, with pedicels much the same length as the hydrothecae; pedicel tapering into base of hydrotheca, and the hydrotheca increasing in diameter very gradually to the margin, so that the hydrotheca is not far from being tubular; margin entire, sometimes duplicated; diaphragm delicate, much like that in *Lictorella*.

The whole colony is almost free of annulations; occasionally there is one near the proximal end of the branch and one or two throughout its length, always appearing singly.

Gonosome.—Unknown.

Type.—U.S.N.M. No. 43434. Taken by the United States Fisheries steamer *Albatross* southeast of Cape Cod, latitude 39°22'50'' N., longitude 68°25' W., 1,608 fathoms, July 19, 1883.

This species can be put in this genus only provisionally, since no gonosome was present in the material. It is doubtful even whether it should be placed in the Campanularidae, since the diaphragm is not typically campanularian.

Genus GONOTHYRAEA Allman

GONOTHYRAEA INTEGRAL, new species

PLATE 32, FIGURE 3

Trophosome.—Colonies minute, less than 8 mm. in length, unbranched, with one branch, or with very few branches; stem slender, slightly geniculate, annulated at the base and above each node; hydrothecae regularly alternate from pedicels that are annulated at both ends, leaving only a small part free of annulations; hydrothecae broadly campanulate, almost or quite as deep as wide; margin entire.

Gonosome.—Gonangium oval or obovate, supported on short, annulated pedicels, growing from the axils of the hydrothecal pedicels.

Type.—U.S.N.M. No. 43435. Taken by the United States Fisheries steamer *Fish Hawk*, $1\frac{1}{4}$ miles from North Light, Block Island, east of Long Island, N. Y., on *Sargassum* dredged in 13 fathoms, August 24, 1880.

This species was associated with *Gemmaria costata*, *Clytia cylindrica*, *Halecium bermudense*, and *Aglaophenia minuta*, all, at times, Gulf weed species. The *Sargassum* must have drifted north in the Gulf Stream and then been sidetracked to sink in this location.

Genus EGMUNDELLA Stechow

EGMUNDELLA FASCICULATA, new species

PLATE 32, FIGURE 4

Trophosome.—Colonies strongly fascicled in the basal portion, reaching a height of 35 mm.; the terminal portion of the main stem and of the branches simple; the simple portion may be short or rather long, supporting several hydrothecae; stems, branches, and pedicels smooth, or at the most slightly wavy, no distinct annulations; the pedicels growing from the fascicled portion of the stem are commonly longer than those from the simple stem or portion of branch.

Hydrotheca broadening gradually and slightly toward the distal end; operculum of rather few segments, 8 or at most 10.

On the fascicled portion of the stem and on the pedicels arising from that portion, there are numerous large nematophores, singly or in groups of two or three; none was observed on the simple portion of the stem or branches.

Gonosome.—Unknown.

Type.—U.S.N.M. No. 43436. Taken by the United States Fisheries steamer *Fish Hawk* off Marthas Vineyard, latitude $40^{\circ}03'$ N., longitude $70^{\circ}31'$ W., 100 fathoms, August 31, 1881.

Genus STEGOPOMA Levensen

STEGOPOMA FASTIGIATA (Alder)

PLATE 33, FIGURE 5

Calycella fastigiata ALDER, Ann. Mag. Nat. Hist., ser. 3, vol. 3, p. 73, 1860.

Trophosome.—Individual hydrothecae growing at irregular intervals from a smooth, slender stolon, definitely pedicellate, straight, almost tubular, but rather rapidly tapering to the pedicels; operculum consisting of the regular two membranes meeting along a ridge, with the walls of the hydrotheca produced to form a gable to support the operculum.

Gonosome (not previously described).—Gonangium arising from the stolon with a pedicel similar to that of the hydrotheca, similar in shape but much larger and somewhat curved; distal end obliquely truncate, narrowed but slightly: sporosacs few, similar in appearance to those in the genus *Gonothyraea*.

Type.—U. S. N. M. No. 43437. Taken by the United States Fisheries steamer *Fish Hawk* off Marthas Vineyard, latitude 40°03' N., longitude 70°31' W., growing over a *Halécium* in 100 fathoms, August 23, 1881.

Genus *HALECIUM* Oken

HALECIUM DIMINUTIVUM, new species

PLATE 33, FIGURE 6

Trophosome.—Colony minute from a creeping stolon, with no continuous main stem; a simple pedicel grows from the stolon, giving rise to a flaring hydrophore, terminally; in some cases, just below the hydrophore, a second pedicel may be given off, turning upward abruptly at the base; in one instance this is repeated so that there are three hydrophores in the colony; this colony had a total length of 1.2 mm. The stolon is not annulated, but the pedicels are decidedly so; the interspace extends outward to a decided ridge so that the surface of the pedicel is much more irregular than in ordinary annulated pedicels or stems.

Gonosome.—Unknown.

Type.—U.S.N.M. No. 43438. Taken by the United States Bureau of Fisheries on Nantucket shoals, on *Sertularella*, depth not given.

EUPERISIPHONIA, new genus

Trophosome.—Colony with a stout, rigid stem and somewhat slenderer, but still rigid, branches. Stem and branches fascicled, the fascicle consisting of an axial tube, bearing hydrothecae, and several peripheral tubes that are nonthecate. The hydrothecae are regularly alternate, loosely adherent for a portion of their length. On the main portion of the axial tube there are no nematophores, but one is present at the base of each hydrotheca. The peripheral tubes are provided with numerous long, slender nematophores.

The trophosome of this species resembles that of *Perisiphonia* but differs from it in having adherent hydrothecae and nematophores at the base of the hydrothecae.

Gonosome.—Unknown.

Genotype.—*E. rigida*, new species.

EUPERISIPHONIA RIGIDA, new species

PLATE 33, FIGURE 7

Trophosome.—Colony consisting of a straight, rigid, fascicled stem (largest fragment 3.5 cm.) and stiff, straight branches given off in subopposite pairs, almost at right angles to the stem. The axial tube is slender, with hydrothecae arranged in regular alternation. Hydrotheca on a short pedicel, tubular, with a sharp curve, so that the distal portion is almost at right angles to the proximal portion, with a distinct perisarcial thickening in the concavity; the basal portion, at least one-half, is adherent to the stem, from which it is readily separated by immersion in hot, weak potash solution. There may be one or two reduplications of the margin, which is entire. There is a nematophore on each pedicel, near the base of the hydrotheca.

The peripheral tubes are more numerous in the proximal portion of both stem and branches, but they do not disappear entirely even at the tips of the branches; they bear no hydrothecae, but the long, slender nematophores are numerous.

Gonosome.—Unknown.

Type.—U.S.N.M. No. 43439. Taken by the United States Fisheries steamer *Albatross* in Yucatan channel, latitude 20°59'30" N., longitude 86°23'45" W., 130 fathoms, January 22, 1885.

Genus DIPHASIA Agassiz**? DIPHASIA CRASSA, new species**

PLATE 33, FIGURE 8

Trophosome.—Stem heavy and coarse, rigid, and straight, divided into regular internodes by transverse nodes; each internode with a proximal pair of opposite hydrothecae, then an opposite pair of branches, followed by two opposite pairs of hydrothecae. Branches given off in opposite pairs from the stem are slenderer than the stem but still stiff and rigid; constrictions between the pairs of hydrothecae form rather indefinite nodes. Hydrothecae opposite, although there may be a single one at the proximal end of the branch, cylindrical, curved slightly outward, adnate for the greater part of their length; margin entire or very slightly sinuous, sometimes with reduplications; operculum delicate, of one adculine flap.

Gonosome.—Unknown.

Type.—U.S.N.M. No. 43440. Taken by the United States Fisheries steamer *Albatross*, southwest coast of Chile, latitude 51°12' S., longitude 74°13'30" W., 258 fathoms, February 6, 1888.

EXPLANATION OF PLATES

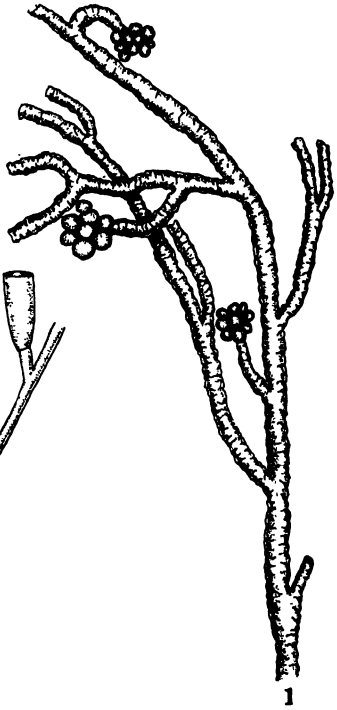
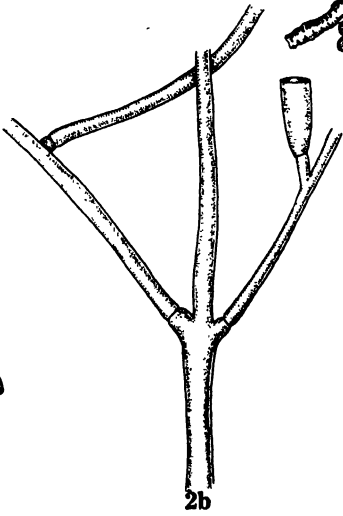
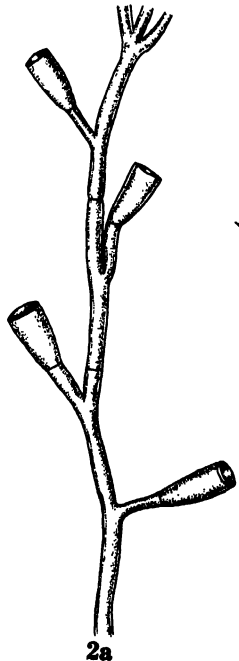
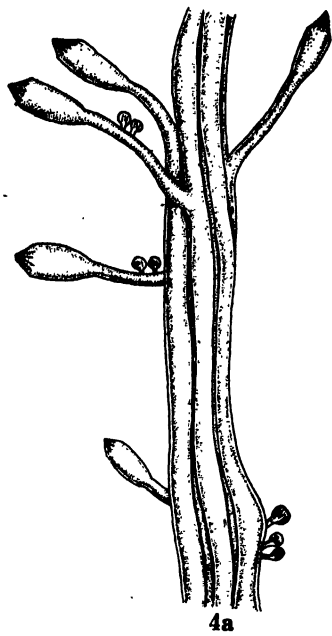
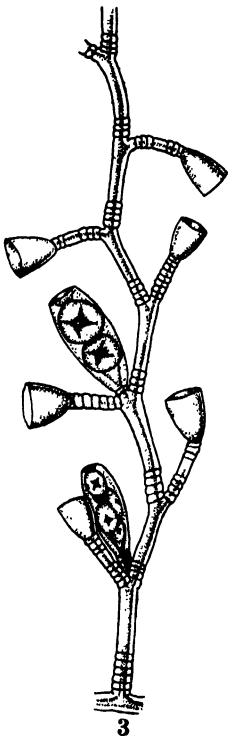
(All figures magnified approximately 20 diameters)

PLATE 32

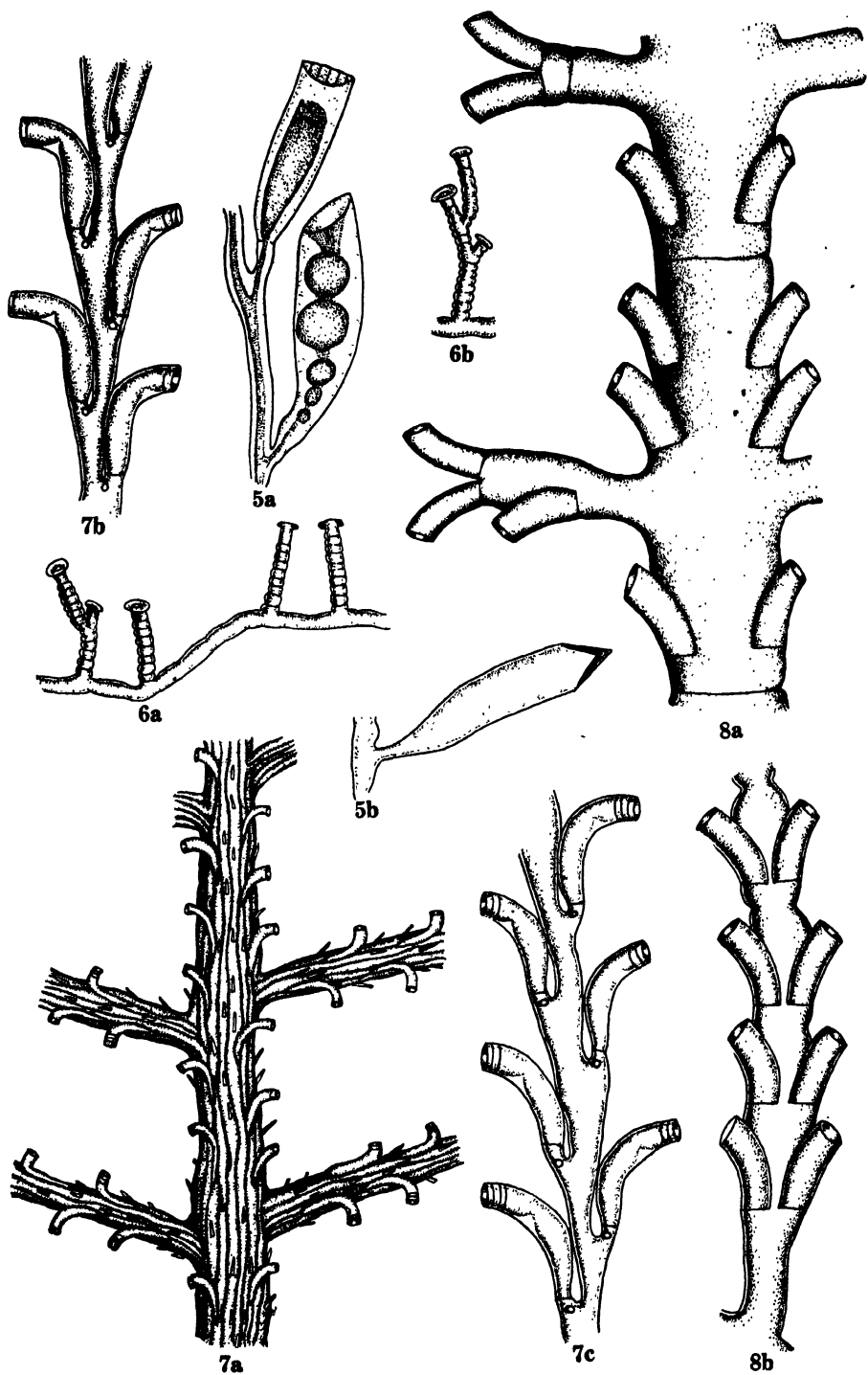
1. *Eudendrium rugosum*: Portion of colony showing the wrinkled perisarc and the male gonophores.
2. *Campanularia abyssa*: *a*, Portion of colony showing nature and arrangement of the hydrothecae; *b*, portion of colony showing branching.
3. *Gonothyraea integra*: Portion of colony showing hydrothecae and gonophores.
4. *Egmundella fasciculata*: *a*, Portion of fascicled stem showing position of the nematophores; *b*, portion of simple stem without nematophores.

PLATE 33

5. *Stegopoma fastigiata*: *a*, Portion of colony showing hydrotheca and gonophore; *b*, another view of the hydrotheca.
6. *Halcetum diminutivum*: *a*, Portion of stolon with single hydrophores and one colony with two hydrophores; *b*, a colony with three hydrophores.
7. *Euperisiphonia rigida*: *a*, Portion of colony showing fascicled stem and branches; *b*, portion of the axial tube bearing hydrothecae; *c*, portion of the axial tube with the hydrothecae separated from the wall of the tube.
8. *Diphastia crassa*: *a*, Portion of main stem showing the proximal part of the opposite branches; *b*, portion of branch showing arrangement of the hydrothecae.



NEW ATLANTIC HYDROIDS.
FOR EXPLANATION SEE PAGE 580.



NEW HYDROIDS.

FOR EXPLANATION SEE PAGE 580.



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A PREHISTORIC ROULETTE FROM WYANDOTTE COUNTY, KANSAS

By WALDO R. WEDEL and HARRY M. TROWBRIDGE

IN the *American Anthropologist* for 1892, in two papers under the title "Studies in Aboriginal Decorative Art," Dr. W. H. Holmes discussed the use of the stamp or figured paddle by native potters of the Eastern United States. The second of these articles, devoted to "the rocking stamp or roulette," pointed out the logical relationship evidenced in decorative techniques between certain simple stamped wares of the Ohio-Illinois-Indiana area and a rouletted or rocked stamp ware (since termed Hopewell or Hopewellian) more widely distributed in the upper Mississippi Basin. Holmes indicated the relative ease with which straight wooden (?) stamps or dies with carved ends, such as those suggested by sherds "coming from the vicinity of Naples, Scott county, Illinois," could have developed into handled forms with curved edge or face, and these in turn into a wheellike type of implement. By mounting a notched cardboard disk on a penholder, and inking the edge of the disk, he produced broken-line designs closely resembling the impressions characteristic of his rouletted pottery ware (1892b, pl. 2, fig. 1; 1903, fig. 72). His observations ended on the somewhat pessimistic note (1892b, p. 152) that—

It is not to be expected that examples of these notched decorating tools will ever be recovered. Their burial with the dead would at best be of rare occurrence; besides, they were probably of wood and thus subject to rapid decay unless buried with copper or imbedded in some form of preservative salts. The exact form of the tool as a whole cannot be fully determined, but there need be no question as to its general character and the methods of its use.

Despite the accumulating wealth of archeological materials in subsequent years, there has been a notable absence of recorded artifacts that could with certainty be regarded as tools for producing indented pottery decoration. A brief search of the literature suggests a tacit assumption by some archeologists that a notched wheellike object was used, as when they speak of "roulette" impressions (e. g., McKern, 1931; Setzler, 1933; Cole and Deuel, 1937). Others, perhaps with less faith in Holmes' experiments, have preferred a less committal term such as "curved dentate stamp," "notched rocker," etc. Willoughby (1922, p. 92), describing pottery from the Turner mound group, speaks of "zigzag patterns which were not made with a roulette, as suggested by Holmes, but with a tool more or less gouge-shaped, having a plain or notched edge, which was pressed against the soft clay with a rocking motion, each opposite corner being raised and slightly advanced alternately, the tool not being wholly lifted from the vessel."

All these various terms and interpretations suggest devices by which clay vessels *could* have been ornamented, but so far as we are aware none rests on incontrovertible archeological evidence derived from the finding of the envisioned implements. More recently it has been demonstrated in the laboratory that certain pottery markings found at Marksville, La., in all probability represent impressions from the edge of a bivalve marine mollusk of the scallop or pecten family (Setzler, 1934, fig. 44, middle row; and unpublished notes). Fewkes (1937, p. 148) has described a flat elliptical end-notched stone object from Minnesota "that is unquestionably a stone stamp used for imprinting the roulette design on unfired clay." The same writer, scouting Holmes' theory of a roulette because of lack of supporting evidence, offers no alternative explanation for the even continuous lines of indented impressions that sometimes encircle, or partially cover the decorated surfaces of, vessels from the Hopewellian area.

In 1939 the junior writer was engaged in excavations at a small prehistoric village site about a mile south of the Missouri River near Bethel, Wyandotte County, Kans. Occupational debris, including sherds of varying types, worked and unworked flints, bone artifacts, limestone fragments, broken animal bones, charcoal, and burnt clay, occurs here in a dark horizon about 18 inches thick and in circular pits, overlain by about 22 inches of culturally barren colluvial soils. Up to the present time digging has been confined to the gullied margin of the site overlooking a small unnamed creek. Owing to the thickness of overburden, modern cultivation has not as yet disturbed the greater portion of the site along the creek bank. In most particulars the remains so far found appear to parallel others recovered by the United States National Museum in 1937 at the Renner site 5 or 6 miles to

the northeast in Platte County, Mo. (Wedel, 1938). Tentatively, both sites have been assigned to a western Hopewellian manifestation.

On June 11, 1939, a small object at first believed to be made of bone was uncovered near the southern border of the site. It was 14 inches below the top of the cultural horizon, at a depth below the present surface of 26 inches. Unassociated with any feature indicative of its use, it had apparently been discarded by its aboriginal owner because of breakage. On January 15, 1940, it was forwarded to the National Museum for examination by the senior writer.

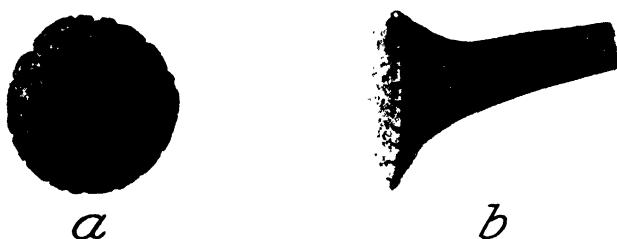


FIGURE 49. End and side views of roulette ($\times 1$).

The material of which the specimen was fashioned, though superficially much altered in the process of dressing and finishing, is tentatively identified by the division of mammals, United States National Museum, as deerhorn from a "spike" buck. The base of the horn has been ground off about the edges, where the "burr" normally occurs, and is convex in profile. Above this base the specimen contracts rapidly in size, tapering out to a round stem carved from the shaft of the horn, and broken at the end. Its general appearance thus is much like the head and upper end of an ordinary straight pin. The head of the "pin" is slightly elliptical (fig. 49, *a*) and measures 22 by 24 mm. The periphery, thin and sharpish (fig. 49, *b*), has 19 small V-shaped notches, which are unequally spaced. At the broken end the stem is 6 mm. in diameter. The overall length, which offers no clue to the original length, is now about 35 mm. As is shown in figure 49, *b*, the stem is not in the center of the head, nor does it rise at a right angle with the plane of the notched edge. This placement, in all probability dictated by the natural conformation of the raw material, is most advantageous for the use to which the object, in our opinion, was put. All the surfaces have been smoothed, and the notched edge appears to be well worn.

When the implement, held lightly between thumb and index finger, is rolled in plastic clay it leaves a curved V-shaped line interrupted by low transverse ridges $1\frac{1}{2}$ to 3 mm. apart. With very little effort a symmetrical curve 25-35 mm. long can be made; longer lines up to 50 or 55 mm. are probably possible, but when made by inexperienced hands these tend to lose their uniformly even curve. At the end of a

line, if the object be rolled back at a slightly different angle but without lifting it from the clay, a second line of indentations results. This procedure, repeated indefinitely, produces a band of "dentate rocker" impressions that duplicate in every essential the markings on sherds actually found at the Trowbridge site (cf. figs. 50, *a*, and 50, *b*). In the sherd illustrated (fig. 50, *b*) the markings made by the native potter differ from those produced on plasticine in the laboratory (fig. 50, *a*) in being more closely spaced and somewhat deeper. The greater depth is probably due to the use of a sharper or less worn tool.

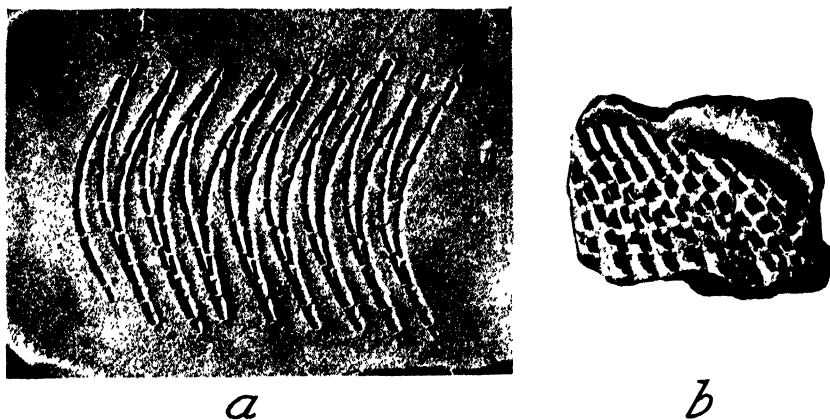


FIGURE 50.—Impressions produced on plastic clay (*a*) by roulette, compared with rouletted sherd (*b*) from Trowbridge site, Wyandotte County, Kans.

From our experiments and field observations, we are led to believe that this type of tool, with certain easily made variants, was in general use among the potters of the Trowbridge, Renner, and culturally related sites of the Kansas City area. The off-center and oblique placement of the handle, together with a slightly elongate wheel, forms an ideal combination for making curved rocker impressions. Smooth or edentate rocker marks, which decidedly predominate over the dentate style in this locality, could have been produced with an identical implement from which the rim notches had been omitted. Owing to the eccentric placement of the handle, a continuous indented line tends to be wavy and undulating, though an experienced operator would probably have better success than we. But this difficulty could be easily remedied: a centrally placed handle at right angles to the plane of the working edge would permit the easy production of straight lines of any desired length. Given the essential idea, as in the present specimen, it is within the bounds of reason and probability that two variants, though not yet recognized in the local archeology, were known and used in aboriginal times.

While we incline to the view that this interpretation of certain characteristic decorative techniques in the Kansas City locale may be applicable over a very much wider area in the Mississippi-Ohio region, there is no attempt to assert here that all pottery showing indentations or rocker marks was necessarily worked over with a tool of identical type. Simple toothed stamps, both straight and curved, were used to a limited extent at the Renner and Trowbridge sites for roughening portions of the vessel surfaces, and compound stamp impressions occur on sherds from neighboring sites. It is possible that still other types of implements with curved edges such as the shells already mentioned served occasionally to produce rocker impressions. Forms without side handles, however, must have been much more awkward to use or would at any rate seem to involve more tiring movements of the wrist and hand. The roulette from the Trowbridge site, requiring little more than a simple rolling motion of the fingers, operates with an ease and effectiveness that would seem difficult or impossible to equal with flat end-notched objects, sticks, gougelike forms, or shells unless they were in some way provided with a handle. We concur in Holmes' observation (1892b, p. 150) that —

Mounting upon a handle is essential to the free and proper use of this tool [i. e. the curved-edge stamp]. The step from the use of the curved edge to the employment of a wheel is a slight one, although the advantage gained is very great. Mounted upon a handle the notched wheel * * * may be revolved at will encircling the vessel or giving lines or filling spaces of any length.

It may be noted that sherds from the Renner and Trowbridge sites, where ornamented with vertical rocker marks, characteristically appear to have the convex side of the marks to the right as one views the upright pot or potsherd. The Trowbridge roulette, however, when held in the right hand, produces curves convex to the left. Does this mean that the ancient potters here were left-handed? Or, if right-handed, did they invert or lay the pots on the side to apply the ornamentation? Or, again, did they lean over the upright pot and work on the far side?

It is unfortunate that the handle of this implement is broken off. Were the degree of taper manifested by the remaining stub continued 3 to 5 cm. farther, one would suspect that the tip could have been used in making the punched bosses frequently found on local rim sherds (Wedel, 1938, pl. 3, F-I).

In our opinion, this specimen fully vindicates Holmes' theory that a type of roulette was part of the material equipment of the native potters who produced the "rouletted" wares of the upper Mississippi Basin. It is immaterial that the technique often used was rocking or partial rolling, since this can be done quite as effectively and easily —perhaps more so—with a notched disk as with any other primitive tool. As for the long indented lines sometimes found on

pottery of the region (Wedel, 1938, pl. 7A; Holmes, 1892b, pl. 2, fig. 2), these must often have been produced by a continuously rolled wheel rather than by the repeated application of a straight stamp. The apparent absence of roulettes from most archeological sites may indeed be due, as Holmes suggested, to the fact that they were customarily made of wood or other perishable substance. Alternatively, it may reflect only the relatively small amount of excavation performed at village sites whose inhabitants, to judge from the decorative techniques shown by their pottery remains, might be suspected of having possessed such tools. A careful reexamination of extant collections might bring to light specimens similar to that described herein that are now otherwise classified as ornaments or problematical forms. In any event, whatever the eventual distribution of wheellike specimens of this nature proves to be, and granting the probability that simpler noncircular rockers and curved-edge stamps existed, we submit that the Trowbridge find substantiates (cf. Fewkes, op. cit.) " 'rouletting' on the principle of wheel-rolling, as originally deduced by Holmes * * * in aboriginal American ceramics."

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